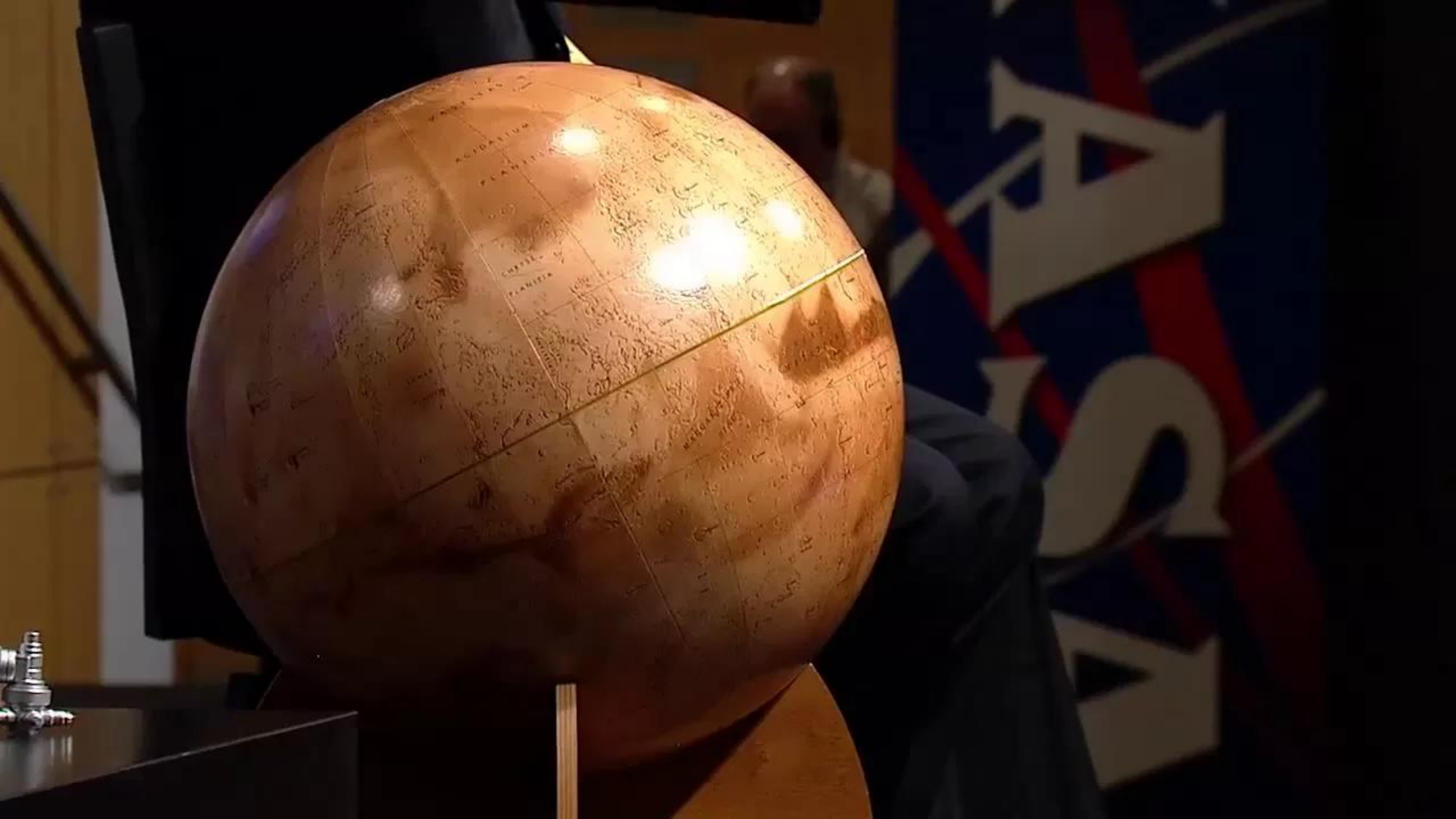

1
00:00:04,870 --> 00:00:02,869
good afternoon and welcome to nasa

2
00:00:07,190 --> 00:00:04,880
headquarters i am nasa public affairs

3
00:00:09,270 --> 00:00:07,200
officer trent parado today marks an

4
00:00:11,110 --> 00:00:09,280
important day an important anniversary

5
00:00:13,190 --> 00:00:11,120
in recent nasa history as one year ago

6
00:00:15,270 --> 00:00:13,200
the mars science laboratory's curiosity

7
00:00:17,430 --> 00:00:15,280
rover landed on mars to begin its

8
00:00:19,189 --> 00:00:17,440
mission of scientific exploration it

9
00:00:20,790 --> 00:00:19,199
dared us all to do

10
00:00:22,630 --> 00:00:20,800
mighty things and it may have even

11
00:00:24,390 --> 00:00:22,640
brought back the mohawk we have a very

12
00:00:27,029 --> 00:00:24,400
exciting event planned for all of you

13
00:00:28,630 --> 00:00:27,039

today um we will hear a little bit about

14
00:00:30,390 --> 00:00:28,640
the science and the some of the science

15
00:00:32,229 --> 00:00:30,400
highlights the mission has enabled

16
00:00:34,150 --> 00:00:32,239
over the last year we'll talk a little

17
00:00:36,389 --> 00:00:34,160
bit about the robotic follow-on missions

18
00:00:38,310 --> 00:00:36,399
that'll that are planned for mars in its

19
00:00:40,389 --> 00:00:38,320
footsteps of course talk about new

20
00:00:41,830 --> 00:00:40,399
technologies and development at nasa and

21
00:00:43,830 --> 00:00:41,840
some of the work happening around the

22
00:00:45,670 --> 00:00:43,840
country and in space to enable that

23
00:00:48,150 --> 00:00:45,680
ultimate agency goal of a human mission

24
00:00:49,990 --> 00:00:48,160
to mars in the 2030s this will of course

25
00:00:52,069 --> 00:00:50,000
include a very special and rare

26
00:00:54,150 --> 00:00:52,079
opportunity to talk to chris cassidy and

27
00:00:55,350 --> 00:00:54,160
karen nyberg who are currently the two

28
00:00:56,950 --> 00:00:55,360
u.s crew members aboard the

29
00:00:59,029 --> 00:00:56,960
international space station for

30
00:01:00,950 --> 00:00:59,039
expedition 36 so that'll be a fun

31
00:01:03,270 --> 00:01:00,960
opportunity we're looking forward to it

32
00:01:04,549 --> 00:01:03,280
so if you're joining us online you can

33
00:01:06,950 --> 00:01:04,559
of course find out more about the

34
00:01:08,950 --> 00:01:06,960
mission at nasa.gov curiosity you can

35
00:01:11,830 --> 00:01:08,960
ask us questions

36
00:01:14,070 --> 00:01:11,840
on social media you can find us at nasa

37
00:01:17,030 --> 00:01:14,080
and at mars curiosity and of course you

38
00:01:18,710 --> 00:01:17,040

can um use the hashtag oneyear on mars

39
00:01:19,910 --> 00:01:18,720
to join the conversation there use the

40
00:01:22,149 --> 00:01:19,920
hashtag

41
00:01:24,230 --> 00:01:22,159
ask nasa excuse me if you have questions

42
00:01:25,270 --> 00:01:24,240
for us and our speakers as we go through

43
00:01:28,710 --> 00:01:25,280
the event

44
00:01:31,030 --> 00:01:28,720
talking a bit about science our first

45
00:01:33,510 --> 00:01:31,040
speaker directs the planetary portfolio

46
00:01:35,510 --> 00:01:33,520
at nasa that means every mission on or

47
00:01:37,749 --> 00:01:35,520
around other planets in the solar system

48
00:01:39,670 --> 00:01:37,759
even the not a planet pluto we have a

49
00:01:41,510 --> 00:01:39,680
mission headed there but it certainly

50
00:01:43,749 --> 00:01:41,520
includes the current and planned

51
00:01:45,429 --> 00:01:43,759
follow-on missions to mars officially he

52
00:01:46,710 --> 00:01:45,439
is the planetary division director for

53
00:01:48,550 --> 00:01:46,720
the science mission directorate here at

54
00:01:54,630 --> 00:01:48,560
nasa headquarters in washington please

55
00:01:59,270 --> 00:01:56,230
thank you

56
00:02:02,469 --> 00:01:59,280
indeed i want to welcome you on our

57
00:02:04,630 --> 00:02:02,479
first anniversary uh of curiosity

58
00:02:09,990 --> 00:02:04,640
landing on mars and if i could have my

59
00:02:14,229 --> 00:02:12,869
there we go and in particular i want to

60
00:02:17,510 --> 00:02:14,239
talk to

61
00:02:18,949 --> 00:02:17,520
that new generation delmar's generation

62
00:02:23,110 --> 00:02:18,959
these are

63
00:02:25,030 --> 00:02:23,120

are individuals that believe and will be

64
00:02:26,470 --> 00:02:25,040
going with us to mars

65
00:02:27,750 --> 00:02:26,480
they of course

66
00:02:29,990 --> 00:02:27,760
perhaps will

67
00:02:32,309 --> 00:02:30,000
think of mars in this way standing on

68
00:02:35,589 --> 00:02:32,319
the surface looking back at the earth

69
00:02:38,229 --> 00:02:35,599
so the mars generation is here today

70
00:02:39,430 --> 00:02:38,239
and our plans are indeed to put humans

71
00:02:42,229 --> 00:02:39,440
on mars

72
00:02:44,070 --> 00:02:42,239
next slide please what i'd like to do

73
00:02:46,550 --> 00:02:44,080
as we go through this

74
00:02:48,309 --> 00:02:46,560
is really talk about some of the past

75
00:02:50,630 --> 00:02:48,319
missions

76
00:02:52,550 --> 00:02:50,640
for us to be able to put humans on mars

77
00:02:55,110 --> 00:02:52,560
we have to take steps

78
00:02:56,630 --> 00:02:55,120
and for our first rover step here is

79
00:02:59,670 --> 00:02:56,640
pathfinder

80
00:03:01,910 --> 00:02:59,680
and of course you called it sojourner

81
00:03:05,030 --> 00:03:01,920
it's our first major step to mars and we

82
00:03:07,190 --> 00:03:05,040
learn so much about how to rove on mars

83
00:03:09,430 --> 00:03:07,200
and and much more about the environment

84
00:03:11,509 --> 00:03:09,440
that existed in and as you can see in

85
00:03:12,869 --> 00:03:11,519
the map you can see where sojourner or

86
00:03:14,949 --> 00:03:12,879
pathfinder

87
00:03:17,589 --> 00:03:14,959
was located on mars

88
00:03:21,270 --> 00:03:19,750

our next environment

89
00:03:22,470 --> 00:03:21,280
was indeed

90
00:03:25,910 --> 00:03:22,480
this one

91
00:03:28,309 --> 00:03:25,920
this is the mars exploration rover uh

92
00:03:30,070 --> 00:03:28,319
you named it curiosity we had another

93
00:03:31,750 --> 00:03:30,080
one called spirit

94
00:03:34,309 --> 00:03:31,760
and these as you can see in the

95
00:03:35,750 --> 00:03:34,319
particular graphics show us where spirit

96
00:03:40,229 --> 00:03:35,760
and opportunity

97
00:03:43,190 --> 00:03:40,239
spirit unfortunately is no longer

98
00:03:46,149 --> 00:03:43,200
operating but opportunity is doing well

99
00:03:49,030 --> 00:03:46,159
it's wintering over right now as we move

100
00:03:51,750 --> 00:03:49,040
from summer into into the winter season

101
00:03:54,229 --> 00:03:51,760
and it's doing a great job living 10

102
00:03:56,630 --> 00:03:54,239
years in a time when we only thought it

103
00:04:00,229 --> 00:03:56,640
might live three or four months

104
00:04:02,470 --> 00:04:00,239
our latest rover of course is curiosity

105
00:04:05,830 --> 00:04:02,480
now this is a nice little mock-up of

106
00:04:08,309 --> 00:04:05,840
curiosity it's huge it's about the size

107
00:04:10,710 --> 00:04:08,319
of your suv and even this doesn't do it

108
00:04:13,030 --> 00:04:10,720
justice the top of curiosity is actually

109
00:04:15,190 --> 00:04:13,040
here and as a six-foot individual i have

110
00:04:17,909 --> 00:04:15,200
to look up to curiosity

111
00:04:20,390 --> 00:04:17,919
uh here's one of the wheels this is a

112
00:04:22,310 --> 00:04:20,400
wheel that we used uh for testing and as

113
00:04:24,469 --> 00:04:22,320

you can see it's gone through the batter

114
00:04:26,870 --> 00:04:24,479
test but that was of course necessary

115
00:04:28,950 --> 00:04:26,880
for us to test all elements of that

116
00:04:32,230 --> 00:04:28,960
seven minutes of terror and actually

117
00:04:34,390 --> 00:04:32,240
making that landing going from 13 000

118
00:04:36,950 --> 00:04:34,400
miles per hour when it hit the top of

119
00:04:39,350 --> 00:04:36,960
the atmosphere to only inches per second

120
00:04:40,870 --> 00:04:39,360
when it actually landed and of course it

121
00:04:42,790 --> 00:04:40,880
landed safely

122
00:04:44,950 --> 00:04:42,800
this time one year ago

123
00:04:48,230 --> 00:04:44,960
and not only as we're going to find out

124
00:04:51,590 --> 00:04:48,240
is it discovering the past of mars it's

125
00:04:53,590 --> 00:04:51,600
actually making major discoveries about

126
00:04:57,350 --> 00:04:53,600
what mars is like today

127
00:04:58,629 --> 00:04:57,360
that's important because our future

128
00:05:00,870 --> 00:04:58,639
is really

129
00:05:03,990 --> 00:05:00,880
uh in our hands

130
00:05:06,550 --> 00:05:04,000
our destiny is to leave low earth orbit

131
00:05:10,550 --> 00:05:06,560
trek out into the solar system the solar

132
00:05:13,670 --> 00:05:10,560
system is ours let's take it and and we

133
00:05:15,909 --> 00:05:13,680
believe humans can actually land on mars

134
00:05:19,110 --> 00:05:15,919
as that ultimate destination for humans

135
00:05:20,790 --> 00:05:19,120
within 20 perhaps 30 years from now

136
00:05:22,790 --> 00:05:20,800
so let me now talk more about the

137
00:05:29,350 --> 00:05:22,800
science

138
00:05:33,590 --> 00:05:31,350

here's where we chose

139
00:05:35,830 --> 00:05:33,600
for curiosity to land

140
00:05:37,590 --> 00:05:35,840
it's called gale crater

141
00:05:39,590 --> 00:05:37,600
and as you can see in this color

142
00:05:42,230 --> 00:05:39,600
rendition of height

143
00:05:45,990 --> 00:05:42,240
the low lands are blue the highlands are

144
00:05:48,070 --> 00:05:46,000
on the order of green and also red and

145
00:05:50,550 --> 00:05:48,080
it's at that boundary between low lands

146
00:05:52,710 --> 00:05:50,560
and highlands we pick that particular

147
00:05:55,350 --> 00:05:52,720
area because we wanted to go for

148
00:05:57,510 --> 00:05:55,360
understanding if mars had a very wet

149
00:05:59,830 --> 00:05:57,520
history in its past we see a lot of

150
00:06:03,189 --> 00:05:59,840
indications that mars has had water on

151
00:06:05,350 --> 00:06:03,199
its surface but we really wanted to see

152
00:06:07,430 --> 00:06:05,360
if water could have existed for long

153
00:06:09,909 --> 00:06:07,440
periods of time this seemed to be the

154
00:06:11,430 --> 00:06:09,919
perfect place it's a low land area and

155
00:06:14,230 --> 00:06:11,440
that of course is where water would

156
00:06:16,150 --> 00:06:14,240
exist next slide please

157
00:06:19,350 --> 00:06:16,160
here's where we landed

158
00:06:22,230 --> 00:06:19,360
right smack dab in our bull's-eye

159
00:06:24,950 --> 00:06:22,240
called a gale crater you can see where

160
00:06:27,110 --> 00:06:24,960
curiosity is as pointed here you can see

161
00:06:28,790 --> 00:06:27,120
where the jets from the sky crane blew

162
00:06:31,270 --> 00:06:28,800
away the top soil

163
00:06:35,110 --> 00:06:31,280

you can see that the sky crane actually

164
00:06:37,590 --> 00:06:35,120
detached and crashed much further away

165
00:06:39,830 --> 00:06:37,600
but you also see areas like this

166
00:06:42,629 --> 00:06:39,840
fractured unit and this critter unit in

167
00:06:45,749 --> 00:06:42,639
this hummocky unit mars was in this

168
00:06:47,749 --> 00:06:45,759
location was just a fabulous opportunity

169
00:06:50,550 --> 00:06:47,759
for us to take a really good look at

170
00:06:52,710 --> 00:06:50,560
what's around us next slide please

171
00:06:56,070 --> 00:06:52,720
and and of course we took our own beauty

172
00:06:58,150 --> 00:06:56,080
picture this is uh 54 frames from our

173
00:07:00,629 --> 00:06:58,160
our arm camera

174
00:07:02,469 --> 00:07:00,639
and uh someone in the community

175
00:07:03,589 --> 00:07:02,479
on the internet did this next slide

176
00:07:05,670 --> 00:07:03,599
please

177
00:07:08,309 --> 00:07:05,680
put the picture together and gave us

178
00:07:10,550 --> 00:07:08,319
gave us a great look of curiosity on its

179
00:07:13,189 --> 00:07:10,560
surface next slide please

180
00:07:15,670 --> 00:07:13,199
all curiosity had to do now was to look

181
00:07:18,070 --> 00:07:15,680
around wake up get its instruments up

182
00:07:19,830 --> 00:07:18,080
and running it looked north towards that

183
00:07:21,589 --> 00:07:19,840
crater rim and of course on the other

184
00:07:24,230 --> 00:07:21,599
side of the crater rim

185
00:07:25,990 --> 00:07:24,240
is that very low lying area

186
00:07:29,110 --> 00:07:26,000
in fact we see

187
00:07:31,029 --> 00:07:29,120
from orbit major scours that

188
00:07:33,430 --> 00:07:31,039

exist in that crater room where water

189
00:07:35,670 --> 00:07:33,440
perhaps poured over and into the crater

190
00:07:38,469 --> 00:07:35,680
itself next slide please

191
00:07:41,029 --> 00:07:38,479
it also looked towards mount sharp

192
00:07:42,629 --> 00:07:41,039
here is its ultimate destination

193
00:07:45,670 --> 00:07:42,639
next slide please

194
00:07:48,150 --> 00:07:45,680
what's really fabulous about mount sharp

195
00:07:50,390 --> 00:07:48,160
are these structures these linear

196
00:07:51,990 --> 00:07:50,400
structures that run across these are

197
00:07:55,110 --> 00:07:52,000
layered sediments

198
00:07:58,230 --> 00:07:55,120
where geologists call this stratigraphy

199
00:08:00,629 --> 00:07:58,240
this is literally the pages of the

200
00:08:02,550 --> 00:08:00,639
history book on mars

201
00:08:05,350 --> 00:08:02,560
by going to mount sharp we're going to

202
00:08:07,990 --> 00:08:05,360
be able to unravel that history and look

203
00:08:10,230 --> 00:08:08,000
at what happened over time and why

204
00:08:13,110 --> 00:08:10,240
mars's climate is so different than what

205
00:08:15,670 --> 00:08:13,120
we believe it existed four billion years

206
00:08:17,830 --> 00:08:15,680
ago next slide please

207
00:08:20,469 --> 00:08:17,840
this little boulder that we point out

208
00:08:22,950 --> 00:08:20,479
this little tiny boulder that's sitting

209
00:08:27,270 --> 00:08:22,960
in front of us is actually the size of

210
00:08:29,029 --> 00:08:27,280
curiosity our one ton suv sized vehicle

211
00:08:31,110 --> 00:08:29,039
next slide please

212
00:08:34,149 --> 00:08:31,120
curiosity began immediately to look

213
00:08:35,829 --> 00:08:34,159

around and begin its science phase and

214
00:08:37,670 --> 00:08:35,839
here's what it found

215
00:08:39,589 --> 00:08:37,680
on the right we see

216
00:08:42,550 --> 00:08:39,599
similar structures on earth these are

217
00:08:46,710 --> 00:08:42,560
conglomerates of rounded pebbles

218
00:08:49,110 --> 00:08:46,720
these are found in dried up river beds

219
00:08:51,670 --> 00:08:49,120
on the right we see exactly the same

220
00:08:54,470 --> 00:08:51,680
thing where curiosity is sitting and in

221
00:08:57,269 --> 00:08:54,480
fact we now believe that curiosity

222
00:08:59,509 --> 00:08:57,279
landed in an ancient riverbed

223
00:09:01,030 --> 00:08:59,519
water that flowed in this area billions

224
00:09:03,910 --> 00:09:01,040
of years ago

225
00:09:05,910 --> 00:09:03,920
maybe for tens of thousands and millions

226
00:09:08,870 --> 00:09:05,920
of years flowed in this particular

227
00:09:10,949 --> 00:09:08,880
region next slide please well this was

228
00:09:12,470 --> 00:09:10,959
exciting discoveries and now we turned

229
00:09:13,829 --> 00:09:12,480
our attention to the next set of

230
00:09:15,910 --> 00:09:13,839
experiments

231
00:09:18,949 --> 00:09:15,920
and that's where the arm could sit down

232
00:09:21,430 --> 00:09:18,959
on a particular location on a rock and

233
00:09:23,910 --> 00:09:21,440
drill next slide please

234
00:09:25,910 --> 00:09:23,920
and so here's the rock that we chose

235
00:09:28,310 --> 00:09:25,920
this is a sedimentary rock this is

236
00:09:30,150 --> 00:09:28,320
material that's been laid over time at

237
00:09:32,630 --> 00:09:30,160
the bottom of what we believe is this

238
00:09:34,949 --> 00:09:32,640

ancient riverbed next slide

239
00:09:37,430 --> 00:09:34,959
it drilled this hole and as we get

240
00:09:40,870 --> 00:09:37,440
closer to it next slide

241
00:09:43,350 --> 00:09:40,880
we see quite clearly that mars is a

242
00:09:44,470 --> 00:09:43,360
different color underneath this red

243
00:09:46,389 --> 00:09:44,480
surface

244
00:09:48,710 --> 00:09:46,399
this is gray mars

245
00:09:51,350 --> 00:09:48,720
this is mars of the past

246
00:09:52,630 --> 00:09:51,360
when we began to analyze this data next

247
00:09:54,470 --> 00:09:52,640
slide please

248
00:09:57,350 --> 00:09:54,480
putting it in our scoop and putting it

249
00:10:00,150 --> 00:09:57,360
in our sophisticated science instruments

250
00:10:02,790 --> 00:10:00,160
we found carbon we found nitrogen we

251
00:10:05,430 --> 00:10:02,800
found oxygen we found phosphorus we

252
00:10:07,509 --> 00:10:05,440
found sulfur we found all the

253
00:10:09,350 --> 00:10:07,519
ingredients of life

254
00:10:12,870 --> 00:10:09,360
as measured in this material that's

255
00:10:17,110 --> 00:10:12,880
deposited in this ancient riverbed

256
00:10:20,310 --> 00:10:17,120
mars was habitable in its past

257
00:10:22,389 --> 00:10:20,320
mars was a blue planet

258
00:10:25,509 --> 00:10:22,399
this has really been a major step

259
00:10:27,430 --> 00:10:25,519
forward in understanding that mars was

260
00:10:30,150 --> 00:10:27,440
much more like earth

261
00:10:32,150 --> 00:10:30,160
many billions of years ago and of course

262
00:10:34,310 --> 00:10:32,160
now we want to understand what happened

263
00:10:35,750 --> 00:10:34,320

to it how did it change from the

264
00:10:39,030 --> 00:10:35,760
environment that was much more

265
00:10:40,550 --> 00:10:39,040
earth-like to what it is today

266
00:10:42,870 --> 00:10:40,560
very dry

267
00:10:45,269 --> 00:10:42,880
and in fact the atmosphere is only a

268
00:10:47,670 --> 00:10:45,279
percent of what ours is in terms of its

269
00:10:49,990 --> 00:10:47,680
pressure and it has quite a bit of

270
00:10:51,269 --> 00:10:50,000
difference in composition next slide

271
00:10:53,269 --> 00:10:51,279
please

272
00:10:55,670 --> 00:10:53,279
here's our destination

273
00:10:57,430 --> 00:10:55,680
it's called mount sharp as seen from our

274
00:11:00,230 --> 00:10:57,440
mars reconnaissance orbiter we're

275
00:11:03,030 --> 00:11:00,240
looking down now in the bottom of gale

276
00:11:04,790 --> 00:11:03,040
crater near the landing site you can see

277
00:11:07,590 --> 00:11:04,800
where we went to glenelg and that's

278
00:11:10,069 --> 00:11:07,600
where we found the conglomerates and and

279
00:11:12,069 --> 00:11:10,079
did the analysis i just referred to

280
00:11:14,389 --> 00:11:12,079
we're heading towards the base of mount

281
00:11:17,990 --> 00:11:14,399
sharp right now we're moving anywhere

282
00:11:20,310 --> 00:11:18,000
from 40 meters to 100 meters per day

283
00:11:22,069 --> 00:11:20,320
now this is about a journey of eight or

284
00:11:24,630 --> 00:11:22,079
so kilometers so it's going to be

285
00:11:27,030 --> 00:11:24,640
several months and along the way we'll

286
00:11:29,430 --> 00:11:27,040
find some fascinating things i know

287
00:11:31,829 --> 00:11:29,440
once we get to the bottom of mount sharp

288
00:11:34,470 --> 00:11:31,839

we're going to have to avoid this this

289
00:11:35,910 --> 00:11:34,480
black area that you see this actually is

290
00:11:38,630 --> 00:11:35,920
our sand dunes

291
00:11:39,670 --> 00:11:38,640
from orbit we see these sand dunes shift

292
00:11:41,750 --> 00:11:39,680
around

293
00:11:44,310 --> 00:11:41,760
and of course as every good golfer knows

294
00:11:46,310 --> 00:11:44,320
we want to stay away from those maneuver

295
00:11:49,750 --> 00:11:46,320
through those and begin to crawl up

296
00:11:53,269 --> 00:11:49,760
mount sharp and begin to analyze these

297
00:11:54,870 --> 00:11:53,279
layers of history this stratigraphy the

298
00:11:56,870 --> 00:11:54,880
laying down of sediments that have

299
00:11:59,350 --> 00:11:56,880
occurred over billions of years and

300
00:12:02,870 --> 00:11:59,360
putting all that together will enable us

301
00:12:05,350 --> 00:12:02,880
to understand what happened to mars

302
00:12:08,230 --> 00:12:05,360
going from a habitable environment as we

303
00:12:11,110 --> 00:12:08,240
now believe it was in its past

304
00:12:12,310 --> 00:12:11,120
to what it is like today and of course

305
00:12:14,710 --> 00:12:12,320
today

306
00:12:17,750 --> 00:12:14,720
that is important data for us to be able

307
00:12:19,910 --> 00:12:17,760
to understand next slide please what our

308
00:12:22,150 --> 00:12:19,920
future might look like

309
00:12:24,870 --> 00:12:22,160
now this actually i i pulled off the

310
00:12:26,790 --> 00:12:24,880
internet only days after this particular

311
00:12:29,910 --> 00:12:26,800
picture was taken

312
00:12:31,190 --> 00:12:29,920
someone from the mars generation

313
00:12:34,790 --> 00:12:31,200

made this

314
00:12:37,590 --> 00:12:34,800
beautiful image of course it is it is uh

315
00:12:39,750 --> 00:12:37,600
overlaid with the with the shadow of

316
00:12:40,949 --> 00:12:39,760
curiosity late in the day as the sun

317
00:12:43,269 --> 00:12:40,959
went down

318
00:12:45,829 --> 00:12:43,279
taking their transformer and a shadow of

319
00:12:48,230 --> 00:12:45,839
that photoshop this in

320
00:12:51,110 --> 00:12:48,240
but in reality this is what humans are

321
00:12:52,870 --> 00:12:51,120
going to look like in 30 years on mars

322
00:12:55,190 --> 00:12:52,880
they're going to have communication with

323
00:12:57,670 --> 00:12:55,200
their orbiters they're going to be

324
00:12:59,750 --> 00:12:57,680
having a set of tools they're going to

325
00:13:01,829 --> 00:12:59,760
be working on mars they're going to be

326
00:13:04,230 --> 00:13:01,839
living on mars and of course they're

327
00:13:07,190 --> 00:13:04,240
going to have their pet dog rover right

328
00:13:08,949 --> 00:13:07,200
there in hand helping them along the way

329
00:13:11,509 --> 00:13:08,959
the next major mission that we're

330
00:13:14,870 --> 00:13:11,519
thinking of along this path

331
00:13:17,990 --> 00:13:14,880
is a rover much like curiosity in terms

332
00:13:20,150 --> 00:13:18,000
of its volume its size and its mass

333
00:13:22,069 --> 00:13:20,160
however it will have a completely

334
00:13:25,269 --> 00:13:22,079
different set of instruments

335
00:13:28,470 --> 00:13:25,279
we're planning to launch that in 2020

336
00:13:30,949 --> 00:13:28,480
we're planning to take that next step

337
00:13:33,350 --> 00:13:30,959
knowing that mars was an environment

338
00:13:35,910 --> 00:13:33,360

that was habitable in its past

339
00:13:38,150 --> 00:13:35,920
we're going to start seeking the signs

340
00:13:40,069 --> 00:13:38,160
of potential life that could have

341
00:13:42,710 --> 00:13:40,079
existed on mars

342
00:13:46,150 --> 00:13:42,720
and that if we can answer that question

343
00:13:48,550 --> 00:13:46,160
will change everything it will tell us

344
00:13:51,750 --> 00:13:48,560
that life not only may exist in our

345
00:13:54,310 --> 00:13:51,760
solar system but throughout our universe

346
00:13:56,710 --> 00:13:54,320
so these are huge steps

347
00:13:58,710 --> 00:13:56,720
and we're making great progress and so

348
00:14:00,230 --> 00:13:58,720
for all of you we want to take you along

349
00:14:02,230 --> 00:14:00,240
in the journey

350
00:14:04,069 --> 00:14:02,240
so with that maybe i can take some

351
00:14:05,189 --> 00:14:04,079
questions in the time i have remaining

352
00:14:08,069 --> 00:14:05,199
thanks very much we have a couple of

353
00:14:09,350 --> 00:14:08,079
roving mics and i think we have

354
00:14:11,030 --> 00:14:09,360
let's see do we have our first question

355
00:14:14,230 --> 00:14:11,040
down here in the front

356
00:14:14,240 --> 00:14:17,430
chuck wallace talking

357
00:14:21,990 --> 00:14:19,189
uh so

358
00:14:24,550 --> 00:14:22,000
what would be your uh what would be your

359
00:14:26,550 --> 00:14:24,560
your top three uh

360
00:14:28,470 --> 00:14:26,560
biggest challenges and things that

361
00:14:29,350 --> 00:14:28,480
you're now happy about

362
00:14:31,430 --> 00:14:29,360
okay

363
00:14:34,150 --> 00:14:31,440

the top three challenges

364
00:14:36,150 --> 00:14:34,160
are indeed making sure that all the

365
00:14:38,870 --> 00:14:36,160
systems are put together in much the

366
00:14:41,829 --> 00:14:38,880
same way that we have with curiosity to

367
00:14:44,310 --> 00:14:41,839
be able to get that next rover down uh

368
00:14:47,110 --> 00:14:44,320
also be able to get the right set of

369
00:14:49,430 --> 00:14:47,120
experiments together that do that major

370
00:14:51,590 --> 00:14:49,440
step in seeking signs of life that would

371
00:14:53,430 --> 00:14:51,600
be the next major one and then of course

372
00:14:55,829 --> 00:14:53,440
we have to find the location that we

373
00:14:58,629 --> 00:14:55,839
want to go to and like real estate it's

374
00:15:01,350 --> 00:14:58,639
location location location you know the

375
00:15:04,069 --> 00:15:01,360
vikings uh in the in the 80s when they

376
00:15:05,990 --> 00:15:04,079
sat down on mars and they they were a

377
00:15:08,310 --> 00:15:06,000
life experiment and they scooped and

378
00:15:10,069 --> 00:15:08,320
made measurements of that they that was

379
00:15:11,750 --> 00:15:10,079
pretty inconclusive in fact most

380
00:15:13,590 --> 00:15:11,760
scientists believe that

381
00:15:15,590 --> 00:15:13,600
that viking results

382
00:15:17,430 --> 00:15:15,600
didn't indicate that there was life on

383
00:15:20,790 --> 00:15:17,440
the surface but

384
00:15:23,990 --> 00:15:20,800
viking landed in modern mars bathed in

385
00:15:26,550 --> 00:15:24,000
ultraviolet radiation and cosmic rays

386
00:15:29,509 --> 00:15:26,560
curiosity has gone to a place that's

387
00:15:32,470 --> 00:15:29,519
been unmodified in three and a half or

388
00:15:35,590 --> 00:15:32,480

so billion years it literally went to

389
00:15:37,750 --> 00:15:35,600
the right place back in time and that

390
00:15:39,430 --> 00:15:37,760
enabled us to really see what mars's

391
00:15:41,509 --> 00:15:39,440
past was like

392
00:15:44,629 --> 00:15:41,519
and that's what we want to do next find

393
00:15:46,389 --> 00:15:44,639
that next fabulous location

394
00:15:48,389 --> 00:15:46,399
undisturbed

395
00:15:50,310 --> 00:15:48,399
in its past where life could have

396
00:15:51,829 --> 00:15:50,320
existed

397
00:15:53,269 --> 00:15:51,839
let's take a quick question from social

398
00:15:54,629 --> 00:15:53,279
media if we could

399
00:15:56,790 --> 00:15:54,639
sure we have a question here from

400
00:15:58,470 --> 00:15:56,800
twitter user sheldon c

401
00:16:00,470 --> 00:15:58,480
has anything you've found on mars in the

402
00:16:03,350 --> 00:16:00,480
past year triggered plans for additional

403
00:16:06,150 --> 00:16:03,360
questions research and exploration

404
00:16:08,790 --> 00:16:06,160
yes indeed just about everything that we

405
00:16:10,069 --> 00:16:08,800
find out we want to know more about for

406
00:16:12,710 --> 00:16:10,079
instance

407
00:16:15,030 --> 00:16:12,720
not to get too technical but we looked

408
00:16:17,189 --> 00:16:15,040
at from the atmospheric instrument

409
00:16:19,189 --> 00:16:17,199
ratios of argon there's different types

410
00:16:22,389 --> 00:16:19,199
of argon one argon heavier than the

411
00:16:25,670 --> 00:16:22,399
other argon doesn't react with anything

412
00:16:27,749 --> 00:16:25,680
but it has a natural amount of each of

413
00:16:30,230 --> 00:16:27,759

those elements throughout the solar

414
00:16:32,230 --> 00:16:30,240
system and when we were at mars and we

415
00:16:35,269 --> 00:16:32,240
made those measurements of argon we

416
00:16:37,749 --> 00:16:35,279
found the lighter argon had left

417
00:16:39,590 --> 00:16:37,759
mostly the heavy argon was there the

418
00:16:42,389 --> 00:16:39,600
only way that could have happened is

419
00:16:45,030 --> 00:16:42,399
that mars atmosphere was stripped away

420
00:16:46,069 --> 00:16:45,040
it changed where did it go how did that

421
00:16:48,870 --> 00:16:46,079
happen

422
00:16:51,030 --> 00:16:48,880
so our next big mission maven which will

423
00:16:52,389 --> 00:16:51,040
be launched in november is designed to

424
00:16:54,389 --> 00:16:52,399
go to mars

425
00:16:56,470 --> 00:16:54,399
be able to orbit and look at how the

426
00:16:58,710 --> 00:16:56,480
solar wind interacts with a planet that

427
00:17:00,949 --> 00:16:58,720
no longer has a magnetic field

428
00:17:02,949 --> 00:17:00,959
you know mars lost its field

429
00:17:04,390 --> 00:17:02,959
billions of years ago

430
00:17:06,230 --> 00:17:04,400
and we want to know why that happened

431
00:17:08,069 --> 00:17:06,240
but we want to see that process and

432
00:17:10,309 --> 00:17:08,079
whether the solar wind actually did the

433
00:17:11,750 --> 00:17:10,319
stripping or something else happened to

434
00:17:13,510 --> 00:17:11,760
its atmosphere

435
00:17:15,669 --> 00:17:13,520
so just each and every one of those

436
00:17:18,630 --> 00:17:15,679
discoveries builds on the next set of

437
00:17:20,549 --> 00:17:18,640
questions we want to answer

438
00:17:22,789 --> 00:17:20,559

show hands for for questions we haven't

439
00:17:31,029 --> 00:17:22,799
gotten to yet

440
00:17:36,789 --> 00:17:33,750
uh there's an mro image

441
00:17:37,669 --> 00:17:36,799
a while back that showed what seemed to

442
00:17:40,310 --> 00:17:37,679
be

443
00:17:43,750 --> 00:17:40,320
liquid water flowing seasonally on mars

444
00:17:45,430 --> 00:17:43,760
there any plans to get closer to things

445
00:17:47,590 --> 00:17:45,440
like that

446
00:17:50,390 --> 00:17:47,600
yes the beautiful images that you were

447
00:17:53,590 --> 00:17:50,400
referring to we actually see fairly

448
00:17:56,070 --> 00:17:53,600
often now because we know where to look

449
00:17:57,750 --> 00:17:56,080
it they occur during the summer when

450
00:17:59,830 --> 00:17:57,760
crater walls

451
00:18:01,190 --> 00:17:59,840
are such that they get the maximum

452
00:18:03,270 --> 00:18:01,200
sunlight

453
00:18:05,270 --> 00:18:03,280
now what must be happening

454
00:18:08,230 --> 00:18:05,280
is that sunlight

455
00:18:10,710 --> 00:18:08,240
is sublimating in other words going

456
00:18:11,669 --> 00:18:10,720
through that process of of solid to

457
00:18:12,789 --> 00:18:11,679
vapor

458
00:18:15,430 --> 00:18:12,799
another

459
00:18:17,669 --> 00:18:15,440
the aquifers that are plugged up

460
00:18:20,230 --> 00:18:17,679
that releases what's inside these

461
00:18:23,990 --> 00:18:20,240
aquifers which we believe are briny

462
00:18:26,789 --> 00:18:24,000
water which flows down the crater walls

463
00:18:29,669 --> 00:18:26,799

you can't go anywhere on this planet and

464
00:18:31,350 --> 00:18:29,679
grab a thimble full of water without

465
00:18:32,390 --> 00:18:31,360
finding life

466
00:18:35,110 --> 00:18:32,400
all right

467
00:18:38,150 --> 00:18:35,120
so the fact that mars has trapped water

468
00:18:41,029 --> 00:18:38,160
inside it still bodes well

469
00:18:42,549 --> 00:18:41,039
for potentially finding life even

470
00:18:45,110 --> 00:18:42,559
perhaps today

471
00:18:47,270 --> 00:18:45,120
well the aquifers are pretty deep

472
00:18:48,630 --> 00:18:47,280
we still have a lot to learn before we

473
00:18:51,430 --> 00:18:48,640
know where to go

474
00:18:53,110 --> 00:18:51,440
we need to understand how close they are

475
00:18:55,669 --> 00:18:53,120
to the surface and where we might be

476
00:18:57,590 --> 00:18:55,679
able to investigate those in the future

477
00:18:59,430 --> 00:18:57,600
in the meantime as i mentioned after

478
00:19:03,029 --> 00:18:59,440
maven will come

479
00:19:05,430 --> 00:19:03,039
uh our our mars rover in 2020 and that

480
00:19:07,830 --> 00:19:05,440
one is going to bore holes into rocks

481
00:19:09,430 --> 00:19:07,840
and look back in the past and it's

482
00:19:11,590 --> 00:19:09,440
really the past

483
00:19:14,630 --> 00:19:11,600
that we have the greatest chance to find

484
00:19:15,669 --> 00:19:14,640
out if mars was ever inhabited that

485
00:19:17,350 --> 00:19:15,679
should leave

486
00:19:20,230 --> 00:19:17,360
remnant material

487
00:19:22,630 --> 00:19:20,240
you know organic carbon all the right

488
00:19:24,630 --> 00:19:22,640

stuff and that's what we want to look at

489
00:19:26,789 --> 00:19:24,640
next that will be our next step but the

490
00:19:29,350 --> 00:19:26,799
briny water is really intriguing and we

491
00:19:31,270 --> 00:19:29,360
do want to follow up on that someday hey

492
00:19:32,470 --> 00:19:31,280
jim before before we uh we lose you

493
00:19:33,750 --> 00:19:32,480
what's um what are the follow-on

494
00:19:36,310 --> 00:19:33,760
missions that we should be looking for

495
00:19:38,390 --> 00:19:36,320
here well the one we're launching in

496
00:19:41,350 --> 00:19:38,400
november is maven

497
00:19:44,310 --> 00:19:41,360
it is an orbiter and it's designed to be

498
00:19:47,029 --> 00:19:44,320
able to look at how the ionosphere and

499
00:19:49,270 --> 00:19:47,039
atmosphere of mars interacts with that

500
00:19:50,230 --> 00:19:49,280
outgassing from the sun called the solar

501
00:19:54,150 --> 00:19:50,240
wind

502
00:19:55,990 --> 00:19:54,160
stripping atmosphere away and we want to

503
00:19:58,470 --> 00:19:56,000
see that process and we want to see what

504
00:20:00,630 --> 00:19:58,480
it's losing and that will tell us a lot

505
00:20:02,870 --> 00:20:00,640
about what's happened to mars

506
00:20:05,190 --> 00:20:02,880
with respect to those processes over

507
00:20:08,549 --> 00:20:05,200
millions and millions of years

508
00:20:10,710 --> 00:20:08,559
our next nasa-led mission is indeed the

509
00:20:13,669 --> 00:20:10,720
2020 rover

510
00:20:16,390 --> 00:20:13,679
we'll launch it in 2020 it will land

511
00:20:18,870 --> 00:20:16,400
about nine months later we will use the

512
00:20:20,950 --> 00:20:18,880
scary sky crane as everyone has called

513
00:20:23,270 --> 00:20:20,960

it in the past we'll relive that seven

514
00:20:25,430 --> 00:20:23,280
minutes of terror i'm sure

515
00:20:27,190 --> 00:20:25,440
but what we put down on the surface will

516
00:20:29,510 --> 00:20:27,200
be a completely different set of

517
00:20:31,430 --> 00:20:29,520
experiments and we'll be taking that

518
00:20:33,990 --> 00:20:31,440
next step along the way

519
00:20:35,029 --> 00:20:34,000
that allows humans to go to mars in the

520
00:20:36,230 --> 00:20:35,039
future

521
00:20:40,549 --> 00:20:36,240
let's give a big round of applause for

522
00:20:40,559 --> 00:20:43,669
okay

523
00:20:46,870 --> 00:20:44,789
so now we're going to talk about one of

524
00:20:49,190 --> 00:20:46,880
my favorite subjects i'm sure many of

525
00:20:51,430 --> 00:20:49,200
yours as well uh which is technology uh

526
00:20:53,029 --> 00:20:51,440
research into space uh you know and the

527
00:20:54,950 --> 00:20:53,039
things that that nasa accomplishes

528
00:20:56,950 --> 00:20:54,960
inevitably improves lives on earth as

529
00:20:58,710 --> 00:20:56,960
well you know through the invention and

530
00:21:00,870 --> 00:20:58,720
innovation of new technologies the

531
00:21:02,390 --> 00:21:00,880
journey to mars it's an asteroid in mars

532
00:21:04,630 --> 00:21:02,400
for for nasa's not going to be any

533
00:21:06,310 --> 00:21:04,640
different our next speaker directs

534
00:21:08,310 --> 00:21:06,320
cross-cutting technology innovation and

535
00:21:09,909 --> 00:21:08,320
development for the agency he is the

536
00:21:12,070 --> 00:21:09,919
acting director of the strategic

537
00:21:14,070 --> 00:21:12,080
integration and analysis office within

538
00:21:16,230 --> 00:21:14,080

the space technology mission directorate

539
00:21:21,190 --> 00:21:16,240
here at nasa please help me welcome pros

540
00:21:26,310 --> 00:21:24,070
thank you uh good afternoon and i'm very

541
00:21:27,590 --> 00:21:26,320
happy to be here um

542
00:21:30,310 --> 00:21:27,600
what i'm going to talk about next slide

543
00:21:33,110 --> 00:21:30,320
please are you know jim uh green just

544
00:21:34,710 --> 00:21:33,120
laid out a nice uh overview of the mars

545
00:21:36,710 --> 00:21:34,720
program from recent history and what

546
00:21:37,909 --> 00:21:36,720
we're planning to do over the next uh 10

547
00:21:41,270 --> 00:21:37,919
years say

548
00:21:42,870 --> 00:21:41,280
um to do robotic explorations but uh

549
00:21:45,029 --> 00:21:42,880
what i'm here going to talk about is how

550
00:21:47,590 --> 00:21:45,039
do we actually put boots on mars you

551
00:21:50,310 --> 00:21:47,600
know one of the things that we as a

552
00:21:52,549 --> 00:21:50,320
country want to do is explore uh deeper

553
00:21:54,230 --> 00:21:52,559
into the space uh beyond low earth orbit

554
00:21:56,390 --> 00:21:54,240
for humans and there are a lot of

555
00:21:58,630 --> 00:21:56,400
challenges for that to occur we've done

556
00:22:00,789 --> 00:21:58,640
a very good job of getting

557
00:22:02,870 --> 00:22:00,799
astronauts into low earth orbit and the

558
00:22:05,190 --> 00:22:02,880
vicinity of the earth moon system

559
00:22:06,950 --> 00:22:05,200
over the years but to get further out

560
00:22:09,830 --> 00:22:06,960
into deep space there are a number of

561
00:22:11,830 --> 00:22:09,840
areas of technology we need to invest in

562
00:22:12,950 --> 00:22:11,840
we've made a number of these investments

563
00:22:15,110 --> 00:22:12,960

and i'm going to talk about what we're

564
00:22:16,310 --> 00:22:15,120
doing now but we need to make some

565
00:22:19,270 --> 00:22:16,320
sustained

566
00:22:21,190 --> 00:22:19,280
investments for a decade or more before

567
00:22:23,750 --> 00:22:21,200
we can get the reliability and some of

568
00:22:25,590 --> 00:22:23,760
the capabilities we need to send

569
00:22:28,630 --> 00:22:25,600
you know astronauts to the surface of

570
00:22:30,870 --> 00:22:28,640
mars or deeper into the solar system and

571
00:22:31,830 --> 00:22:30,880
what this chart kind of uh shows here

572
00:22:37,270 --> 00:22:31,840
are

573
00:22:39,350 --> 00:22:37,280
make some investments and to to really

574
00:22:42,549 --> 00:22:39,360
improve the capabilities and they uh

575
00:22:44,710 --> 00:22:42,559
span many different areas for sending um

576
00:22:47,029 --> 00:22:44,720
spacecraft and humans uh into deeper

577
00:22:48,710 --> 00:22:47,039
space and one is better communications

578
00:22:50,950 --> 00:22:48,720
you know right now we use radio

579
00:22:53,270 --> 00:22:50,960
frequency communications to when we send

580
00:22:55,909 --> 00:22:53,280
robotic spacecraft and even astronauts

581
00:22:58,230 --> 00:22:55,919
into low-earth orbit um but we want

582
00:22:59,510 --> 00:22:58,240
high-band communications when we send

583
00:23:01,590 --> 00:22:59,520
humans we're going to be getting a lot

584
00:23:03,990 --> 00:23:01,600
more data if we want really

585
00:23:06,070 --> 00:23:04,000
video those types of things we want a

586
00:23:07,830 --> 00:23:06,080
high-speed internet basically to be able

587
00:23:09,190 --> 00:23:07,840
to bring those data back to here and so

588
00:23:10,390 --> 00:23:09,200

some of the investments we're making on

589
00:23:11,830 --> 00:23:10,400
is improving the communications

590
00:23:14,710 --> 00:23:11,840
capability

591
00:23:16,470 --> 00:23:14,720
life support obviously to send humans

592
00:23:18,630 --> 00:23:16,480
outside the earth

593
00:23:21,029 --> 00:23:18,640
we require a life support system for

594
00:23:22,470 --> 00:23:21,039
them we have

595
00:23:24,310 --> 00:23:22,480
a lot of experiments going on at the

596
00:23:27,430 --> 00:23:24,320
space station to improve the reliability

597
00:23:29,909 --> 00:23:27,440
of a environmental system for long

598
00:23:31,750 --> 00:23:29,919
duration operation uh we need to test

599
00:23:33,750 --> 00:23:31,760
those out make them much more higher

600
00:23:36,230 --> 00:23:33,760
reliability so when we send astronauts

601
00:23:38,310 --> 00:23:36,240
to deeper space or to mars on a mission

602
00:23:41,350 --> 00:23:38,320
we would have systems that would provide

603
00:23:43,750 --> 00:23:41,360
everything they need for daily living

604
00:23:46,630 --> 00:23:43,760
from breathing to food

605
00:23:48,789 --> 00:23:46,640
recycling waste so on and so forth

606
00:23:50,310 --> 00:23:48,799
because the mission to mars for humans

607
00:23:53,110 --> 00:23:50,320
is going to take anywhere between two to

608
00:23:56,070 --> 00:23:53,120
three years and so it's a long way to go

609
00:23:57,669 --> 00:23:56,080
and a long time to come back and

610
00:23:59,270 --> 00:23:57,679
we can't just go there and fix things

611
00:24:01,190 --> 00:23:59,280
okay so we have to have systems that

612
00:24:02,950 --> 00:24:01,200
will be highly reliable to be able to

613
00:24:05,350 --> 00:24:02,960

take care of the astronauts

614
00:24:08,230 --> 00:24:05,360
to not only live but the reason they're

615
00:24:09,990 --> 00:24:08,240
going there for is to do this scientific

616
00:24:12,310 --> 00:24:10,000
uh investigations that jim talked about

617
00:24:13,750 --> 00:24:12,320
that we do robotic systems with but all

618
00:24:15,990 --> 00:24:13,760
the other things that humans will bring

619
00:24:19,350 --> 00:24:16,000
into that aspect to be able to figure

620
00:24:20,950 --> 00:24:19,360
out uh what's near uh our so what's

621
00:24:24,710 --> 00:24:20,960
within our solar system and near to our

622
00:24:26,390 --> 00:24:24,720
planet uh and mars is really the next

623
00:24:27,510 --> 00:24:26,400
big hurdle for sending humans deeper

624
00:24:29,350 --> 00:24:27,520
into space

625
00:24:31,990 --> 00:24:29,360
um power generating storage they're

626
00:24:33,909 --> 00:24:32,000
gonna need power to operate uh not only

627
00:24:35,750 --> 00:24:33,919
uh what they need the astronauts but all

628
00:24:37,669 --> 00:24:35,760
the equipment to do the analysis or

629
00:24:39,909 --> 00:24:37,679
roving on mars and so on and so forth so

630
00:24:41,590 --> 00:24:39,919
we have to find ways of generating power

631
00:24:42,950 --> 00:24:41,600
and storing it so they can utilize it

632
00:24:45,110 --> 00:24:42,960
for the extended period of times that we

633
00:24:47,190 --> 00:24:45,120
will be doing that

634
00:24:51,029 --> 00:24:47,200
you see you know spirit uh and

635
00:24:52,950 --> 00:24:51,039
opportunity uh curiosity rovers there um

636
00:24:56,070 --> 00:24:52,960
solar power and

637
00:24:57,669 --> 00:24:56,080
curiosity used uh uh a radioisotope

638
00:24:59,269 --> 00:24:57,679

generator to produce the power we're

639
00:25:01,269 --> 00:24:59,279
gonna need a lot more power for when

640
00:25:03,029 --> 00:25:01,279
humans are on the surface with a lot

641
00:25:04,630 --> 00:25:03,039
larger vehicles to be able to operate

642
00:25:07,350 --> 00:25:04,640
those types of systems

643
00:25:09,750 --> 00:25:07,360
logistics how do we pre-position large

644
00:25:11,190 --> 00:25:09,760
things on the surface of mars

645
00:25:13,510 --> 00:25:11,200
curiosity

646
00:25:15,750 --> 00:25:13,520
allowed us to land one metric ton on the

647
00:25:17,990 --> 00:25:15,760
surface of mars

648
00:25:20,149 --> 00:25:18,000
to you that may sound like very big

649
00:25:22,789 --> 00:25:20,159
right it is trust me because i spent my

650
00:25:25,590 --> 00:25:22,799
previous uh i guess life here at nasa at

651
00:25:27,830 --> 00:25:25,600
one of the space centers in

652
00:25:29,190 --> 00:25:27,840
hampton virginia nelson langley as an

653
00:25:30,310 --> 00:25:29,200
entry descent and landing engineer i

654
00:25:32,149 --> 00:25:30,320
helped land actually spirited

655
00:25:33,510 --> 00:25:32,159
opportunity as well as phoenix

656
00:25:35,909 --> 00:25:33,520
so i know the challenge of landing

657
00:25:38,390 --> 00:25:35,919
something uh we barely are able to do a

658
00:25:40,789 --> 00:25:38,400
metric ton now when we send humans

659
00:25:42,470 --> 00:25:40,799
we're trying to land 40 metric tons so

660
00:25:44,630 --> 00:25:42,480
we landed a car

661
00:25:46,789 --> 00:25:44,640
what we need to do is a two-story house

662
00:25:48,870 --> 00:25:46,799
when we send humans to mars how do we do

663
00:25:50,549 --> 00:25:48,880

that we don't have a good method of

664
00:25:51,750 --> 00:25:50,559
doing that right now

665
00:25:53,669 --> 00:25:51,760
and so some of the investments we're

666
00:25:54,950 --> 00:25:53,679
doing is based on

667
00:25:56,789 --> 00:25:54,960
trying to do those types of things i'll

668
00:25:59,350 --> 00:25:56,799
walk you through a few of those

669
00:26:02,390 --> 00:25:59,360
navigation figuring out how precisely we

670
00:26:05,190 --> 00:26:02,400
can get there um manufacturing in space

671
00:26:06,630 --> 00:26:05,200
and and for space we would like to you

672
00:26:08,230 --> 00:26:06,640
know create what we need when we get

673
00:26:10,950 --> 00:26:08,240
there so if we take the what you've

674
00:26:12,710 --> 00:26:10,960
heard of 3d printers we can manufacture

675
00:26:14,789 --> 00:26:12,720
tools if we need to right on the spot if

676
00:26:16,310 --> 00:26:14,799
we don't have something of course if we

677
00:26:18,149 --> 00:26:16,320
didn't bring something and we need

678
00:26:20,149 --> 00:26:18,159
something like that to

679
00:26:21,510 --> 00:26:20,159
repair something or we find something on

680
00:26:23,110 --> 00:26:21,520
the surface of mars that hey we really

681
00:26:24,549 --> 00:26:23,120
would like a tool like this if we didn't

682
00:26:26,070 --> 00:26:24,559
bring it we wouldn't be able to do it so

683
00:26:27,190 --> 00:26:26,080
a lot of investments in 3d printing

684
00:26:29,510 --> 00:26:27,200
we're trying to take it to the next

685
00:26:31,990 --> 00:26:29,520
level where we can actually manufacture

686
00:26:33,990 --> 00:26:32,000
the material we need and then once we're

687
00:26:35,510 --> 00:26:34,000
done with it recycle it so that that

688
00:26:38,789 --> 00:26:35,520

material can be used to create other

689
00:26:40,470 --> 00:26:38,799
things we're also doing food uh um

690
00:26:41,350 --> 00:26:40,480
creation with 3d printers to see if we

691
00:26:43,269 --> 00:26:41,360
can

692
00:26:44,870 --> 00:26:43,279
uh develop food that way for the

693
00:26:47,269 --> 00:26:44,880
astronauts to eat as opposed to getting

694
00:26:48,870 --> 00:26:47,279
some stuff that's freeze-dried for years

695
00:26:50,230 --> 00:26:48,880
upon um

696
00:26:52,070 --> 00:26:50,240
prior to them departing so we're making

697
00:26:54,470 --> 00:26:52,080
investments and trying to figuring out

698
00:26:57,510 --> 00:26:54,480
how to do those things real time

699
00:26:59,590 --> 00:26:57,520
propulsion is a big aspect of how do we

700
00:27:01,190 --> 00:26:59,600
go deeper into space more efficiently so

701
00:27:03,029 --> 00:27:01,200
we can take much more infrastructure

702
00:27:05,350 --> 00:27:03,039
where we need to

703
00:27:06,710 --> 00:27:05,360
to this point we've only done one-way

704
00:27:08,310 --> 00:27:06,720
missions to mars

705
00:27:09,990 --> 00:27:08,320
when we send humans there obviously we

706
00:27:12,149 --> 00:27:10,000
want to bring them back so that would be

707
00:27:15,029 --> 00:27:12,159
a round-trip mission there's no gas

708
00:27:16,789 --> 00:27:15,039
stations on the way okay and so or

709
00:27:18,950 --> 00:27:16,799
convenience stores for example for food

710
00:27:21,590 --> 00:27:18,960
either so we have to take all that with

711
00:27:24,149 --> 00:27:21,600
us and so we need a propulsion system

712
00:27:25,830 --> 00:27:24,159
that will be very efficient to minimize

713
00:27:27,909 --> 00:27:25,840

all what we need to take in particular

714
00:27:29,590 --> 00:27:27,919
the fuel to be able to get to mars do

715
00:27:30,870 --> 00:27:29,600
what we need to do there and come all

716
00:27:33,190 --> 00:27:30,880
the way back

717
00:27:34,950 --> 00:27:33,200
entry descending landing as i mentioned

718
00:27:37,750 --> 00:27:34,960
we have to land something about the size

719
00:27:39,190 --> 00:27:37,760
of a house a two-story house on the

720
00:27:41,029 --> 00:27:39,200
surface of mars and i'll talk about some

721
00:27:42,710 --> 00:27:41,039
of those investments we talked about the

722
00:27:44,149 --> 00:27:42,720
seven minutes of terror

723
00:27:45,830 --> 00:27:44,159
the reason why it's seven minutes is you

724
00:27:47,990 --> 00:27:45,840
fall very quickly

725
00:27:49,269 --> 00:27:48,000
we have to land something very large in

726
00:27:51,029 --> 00:27:49,279
the same amount of time and how can we

727
00:27:52,470 --> 00:27:51,039
land something that big

728
00:27:54,389 --> 00:27:52,480
and then radiation protection obviously

729
00:27:55,750 --> 00:27:54,399
when we go into deeper space we want to

730
00:27:57,510 --> 00:27:55,760
make sure that the astronauts are well

731
00:27:59,430 --> 00:27:57,520
taken care of and so we're making

732
00:28:00,789 --> 00:27:59,440
investments in those areas as well next

733
00:28:02,710 --> 00:28:00,799
chart

734
00:28:05,190 --> 00:28:02,720
so i talked about in space propulsion

735
00:28:07,190 --> 00:28:05,200
that is a large tall temple that we need

736
00:28:08,870 --> 00:28:07,200
to get over and one of the areas we're

737
00:28:11,669 --> 00:28:08,880
investing in right now is solar electric

738
00:28:13,909 --> 00:28:11,679

propulsion uh because it is a very fuel

739
00:28:15,430 --> 00:28:13,919
efficient way of sending things into

740
00:28:16,630 --> 00:28:15,440
deeper space or even around low earth

741
00:28:19,430 --> 00:28:16,640
orbit for that matter and i'll talk

742
00:28:21,110 --> 00:28:19,440
about that in the next chart

743
00:28:23,190 --> 00:28:21,120
so we are investing in propulsion

744
00:28:25,190 --> 00:28:23,200
systems that we can use

745
00:28:29,029 --> 00:28:25,200
new methodologies to be able to send

746
00:28:31,190 --> 00:28:29,039
large equipment at a very efficient low

747
00:28:32,950 --> 00:28:31,200
fuel usage uh we're making investments

748
00:28:35,430 --> 00:28:32,960
in the solar array technology how how we

749
00:28:38,870 --> 00:28:35,440
can use the sun's energy to produce the

750
00:28:41,110 --> 00:28:38,880
power that we need to expel a propellant

751
00:28:43,110 --> 00:28:41,120
like argon or xenon some other type of

752
00:28:45,029 --> 00:28:43,120
thing through an engine and what you see

753
00:28:46,950 --> 00:28:45,039
in there thruster development as well as

754
00:28:48,549 --> 00:28:46,960
a high power processing unit where when

755
00:28:50,230 --> 00:28:48,559
you have something very high powered

756
00:28:52,470 --> 00:28:50,240
that you're generating with those solar

757
00:28:53,990 --> 00:28:52,480
rays you need to condition it so that

758
00:28:55,510 --> 00:28:54,000
you can utilize it for the various

759
00:28:57,430 --> 00:28:55,520
systems be it for propulsion like an

760
00:28:58,950 --> 00:28:57,440
engine or the onboard computers and

761
00:29:01,190 --> 00:28:58,960
everything else we're making investments

762
00:29:03,669 --> 00:29:01,200
in that and then obviously

763
00:29:05,669 --> 00:29:03,679

uh the structure of where we put the

764
00:29:08,389 --> 00:29:05,679
fuel in uh the structure of the

765
00:29:10,870 --> 00:29:08,399
spacecraft of finding lightweight strong

766
00:29:12,230 --> 00:29:10,880
materials that allow us to be able to

767
00:29:14,149 --> 00:29:12,240
put a spacecraft together that's very

768
00:29:16,549 --> 00:29:14,159
lightweight and use that

769
00:29:17,990 --> 00:29:16,559
savings to put into the useful aspects

770
00:29:19,830 --> 00:29:18,000
that the astronauts need and the

771
00:29:21,669 --> 00:29:19,840
equipment we need to go to deep deeper

772
00:29:24,389 --> 00:29:21,679
space so we're making huge investments

773
00:29:27,190 --> 00:29:24,399
in solar propulsion right now

774
00:29:30,630 --> 00:29:27,200
that will go towards uh testing out in

775
00:29:32,950 --> 00:29:30,640
the asteroid uh uh return uh mission

776
00:29:35,029 --> 00:29:32,960
that you many of you heard about as jim

777
00:29:36,389 --> 00:29:35,039
mentioned we did steps from a small

778
00:29:38,070 --> 00:29:36,399
rover to kind of get our feet wet

779
00:29:40,070 --> 00:29:38,080
figuring out how to do that on mars to

780
00:29:41,590 --> 00:29:40,080
larger ones and then ones like you

781
00:29:42,789 --> 00:29:41,600
see here with curiosity we're going to

782
00:29:45,029 --> 00:29:42,799
take the same approach with many of

783
00:29:46,710 --> 00:29:45,039
these systems is test them out with uh

784
00:29:48,549 --> 00:29:46,720
for example this asteroid

785
00:29:51,029 --> 00:29:48,559
retrieval mission of the propulsion

786
00:29:53,269 --> 00:29:51,039
system um how we can we do autonomously

787
00:29:54,630 --> 00:29:53,279
all these aspects of operating in space

788
00:29:57,350 --> 00:29:54,640

when uh

789
00:29:59,830 --> 00:29:57,360
at distances when humans aren't nearby

790
00:30:02,310 --> 00:29:59,840
and then also when we bring this

791
00:30:04,389 --> 00:30:02,320
asteroid closer to us about how

792
00:30:06,149 --> 00:30:04,399
astronauts will live and work in space

793
00:30:08,310 --> 00:30:06,159
going and looking at this asteroid so

794
00:30:10,789 --> 00:30:08,320
those types of investments is what will

795
00:30:12,710 --> 00:30:10,799
allow us to do by working on this astro

796
00:30:14,230 --> 00:30:12,720
retrieval mission and propulsion system

797
00:30:16,230 --> 00:30:14,240
here would be one of the major elements

798
00:30:18,149 --> 00:30:16,240
of that next slide

799
00:30:20,630 --> 00:30:18,159
one of the aspects of solar eclipse

800
00:30:21,990 --> 00:30:20,640
propulsion which is scp

801
00:30:23,750 --> 00:30:22,000
is you can do so many different things

802
00:30:25,669 --> 00:30:23,760
with it and here's just a list of few of

803
00:30:28,070 --> 00:30:25,679
them where in low-earth orbit you can do

804
00:30:30,149 --> 00:30:28,080
satellite servicing where if you want to

805
00:30:32,230 --> 00:30:30,159
refuel a satellite or repair a satellite

806
00:30:34,549 --> 00:30:32,240
you can use this a very efficient way of

807
00:30:36,630 --> 00:30:34,559
getting to it repairing it moving on

808
00:30:38,070 --> 00:30:36,640
delivering payload to higher orbits we

809
00:30:40,149 --> 00:30:38,080
use a traditional rocket to get into a

810
00:30:41,669 --> 00:30:40,159
lower orbit and use the solar propulsion

811
00:30:43,590 --> 00:30:41,679
to boost it the rest of the way it's

812
00:30:47,269 --> 00:30:43,600
much more cost effective and fuel

813
00:30:48,789 --> 00:30:47,279

efficient than uh systems we have now

814
00:30:51,750 --> 00:30:48,799
overall debris

815
00:30:53,110 --> 00:30:51,760
removal and and moving uh so that uh we

816
00:30:55,190 --> 00:30:53,120
can get things out of the way that the

817
00:30:57,430 --> 00:30:55,200
space junk uh it will make those types

818
00:30:59,909 --> 00:30:57,440
of activities much more cost effective

819
00:31:01,750 --> 00:30:59,919
um as well as other missions we wanna do

820
00:31:03,909 --> 00:31:01,760
uh in the solar system where it can send

821
00:31:06,470 --> 00:31:03,919
things out further uh in a much more

822
00:31:08,230 --> 00:31:06,480
cost effective manner uh than uh

823
00:31:10,470 --> 00:31:08,240
traditional rockets that we have today

824
00:31:13,029 --> 00:31:10,480
so it allows us to do a cross cutting

825
00:31:14,230 --> 00:31:13,039
type of uh capability uh with this type

826
00:31:16,149 --> 00:31:14,240
of investment

827
00:31:18,070 --> 00:31:16,159
next slide

828
00:31:20,149 --> 00:31:18,080
so i hear you know it's talked about the

829
00:31:21,990 --> 00:31:20,159
mars uh the challenges of deep space but

830
00:31:23,350 --> 00:31:22,000
here specifically going on mars

831
00:31:25,110 --> 00:31:23,360
challenges i'm not sure if you can read

832
00:31:26,470 --> 00:31:25,120
all the sl uh the wording on there so

833
00:31:27,750 --> 00:31:26,480
i'll walk you through a few of them and

834
00:31:30,070 --> 00:31:27,760
the charts will be available for you

835
00:31:31,590 --> 00:31:30,080
guys to look on the website but surface

836
00:31:33,750 --> 00:31:31,600
power i talked about that once you get

837
00:31:35,430 --> 00:31:33,760
to mars what are you going to do

838
00:31:37,190 --> 00:31:35,440

in terms of power that the astronauts

839
00:31:38,789 --> 00:31:37,200
will leave and the equipment to be able

840
00:31:39,990 --> 00:31:38,799
to do everything we need

841
00:31:41,269 --> 00:31:40,000
life support

842
00:31:43,110 --> 00:31:41,279
we're making investments and i'll talk

843
00:31:45,190 --> 00:31:43,120
about a few of these when on the next

844
00:31:47,269 --> 00:31:45,200
chart when we get there

845
00:31:48,470 --> 00:31:47,279
operating uh on the surface operations

846
00:31:51,190 --> 00:31:48,480
how do you go about doing that with

847
00:31:53,029 --> 00:31:51,200
robots and things to help the astronauts

848
00:31:55,190 --> 00:31:53,039
multitask in many ways to be able to do

849
00:31:57,830 --> 00:31:55,200
that

850
00:31:58,870 --> 00:31:57,840
mars resource utilization

851
00:32:00,230 --> 00:31:58,880
and

852
00:32:01,430 --> 00:32:00,240
ascent from surface you know as i

853
00:32:03,509 --> 00:32:01,440
mentioned we've only done one-way

854
00:32:05,590 --> 00:32:03,519
missions to this point so if we send

855
00:32:07,110 --> 00:32:05,600
humans to the surface of mars we want to

856
00:32:08,789 --> 00:32:07,120
launch them back up

857
00:32:10,389 --> 00:32:08,799
and be able to come back and we want to

858
00:32:11,750 --> 00:32:10,399
in essence live off the land to be able

859
00:32:12,950 --> 00:32:11,760
to do that

860
00:32:14,710 --> 00:32:12,960
entry just in landing i talk about

861
00:32:16,389 --> 00:32:14,720
communications and getting to mars in

862
00:32:17,669 --> 00:32:16,399
terms of in-space propulsion are many of

863
00:32:19,509 --> 00:32:17,679

the same challenges about going deep

864
00:32:21,750 --> 00:32:19,519
space that's going to mars as well next

865
00:32:23,990 --> 00:32:21,760
slide

866
00:32:26,470 --> 00:32:24,000
um this chart basically just takes some

867
00:32:28,389 --> 00:32:26,480
of the solutions that we have into those

868
00:32:30,630 --> 00:32:28,399
eight elements that i just talked about

869
00:32:31,990 --> 00:32:30,640
um i will focus more on the next slide

870
00:32:33,430 --> 00:32:32,000
but it just gives you a few of the areas

871
00:32:36,549 --> 00:32:33,440
so we're talking about a surface power

872
00:32:38,070 --> 00:32:36,559
of fuel cells and batteries as well as

873
00:32:39,909 --> 00:32:38,080
in life support a closed-loop life

874
00:32:41,669 --> 00:32:39,919
support system so we can recycle all the

875
00:32:43,509 --> 00:32:41,679
material that's going on for the

876
00:32:45,269 --> 00:32:43,519
astronauts and so the amount of water we

877
00:32:46,870 --> 00:32:45,279
need to bring the oxygen we need to

878
00:32:48,389 --> 00:32:46,880
bring will be minimized to be able to

879
00:32:50,230 --> 00:32:48,399
reuse those so just a couple of those

880
00:32:52,230 --> 00:32:50,240
elements that uh solutions that we're

881
00:32:53,990 --> 00:32:52,240
talking about next slide

882
00:32:56,230 --> 00:32:54,000
so let me talk about a few of the

883
00:32:57,590 --> 00:32:56,240
elements that in our stmd space

884
00:32:59,590 --> 00:32:57,600
technology mission director which stands

885
00:33:01,269 --> 00:32:59,600
for the advancements we are making uh

886
00:33:02,630 --> 00:33:01,279
you can see on the right-hand side there

887
00:33:04,310 --> 00:33:02,640
on my right

888
00:33:05,669 --> 00:33:04,320

entry descendant land there's a lot of

889
00:33:07,430 --> 00:33:05,679
activities going on

890
00:33:09,590 --> 00:33:07,440
the reason being is we don't know how to

891
00:33:11,509 --> 00:33:09,600
land 40 metric tons and we're trying to

892
00:33:13,110 --> 00:33:11,519
figure out systems to be able to do that

893
00:33:14,950 --> 00:33:13,120
and we're trying to do many different

894
00:33:16,549 --> 00:33:14,960
types because we're not going to know

895
00:33:18,870 --> 00:33:16,559
which one is going to win out in terms

896
00:33:20,630 --> 00:33:18,880
of the best capability but also when you

897
00:33:22,389 --> 00:33:20,640
land something going 13 000 miles per

898
00:33:24,549 --> 00:33:22,399
hour when you get to mars you have to go

899
00:33:26,230 --> 00:33:24,559
through every flight regime to get to

900
00:33:28,470 --> 00:33:26,240
the ground while if you're in an

901
00:33:30,230 --> 00:33:28,480
airplane you go all subsonic so you only

902
00:33:31,590 --> 00:33:30,240
you know remain in one flight regime you

903
00:33:33,190 --> 00:33:31,600
have to have different systems and all

904
00:33:34,630 --> 00:33:33,200
these different hyper

905
00:33:36,710 --> 00:33:34,640
flight regimes to be able to land some

906
00:33:38,470 --> 00:33:36,720
uh these types of things and so you need

907
00:33:39,830 --> 00:33:38,480
systems in all those different areas and

908
00:33:41,509 --> 00:33:39,840
so we need to make investments to figure

909
00:33:42,870 --> 00:33:41,519
out how best to slow down in those

910
00:33:43,590 --> 00:33:42,880
different speed regimes to be able to do

911
00:33:44,950 --> 00:33:43,600
that

912
00:33:47,509 --> 00:33:44,960
uh we're making investments in life

913
00:33:49,509 --> 00:33:47,519

support for closed loop

914
00:33:50,950 --> 00:33:49,519
systems uh we're testing those out on

915
00:33:53,029 --> 00:33:50,960
the ground right now and we will test

916
00:33:54,230 --> 00:33:53,039
them out on the space station so that we

917
00:33:55,669 --> 00:33:54,240
can demonstrate them that they are

918
00:33:57,190 --> 00:33:55,679
working properly like we need to to get

919
00:33:59,190 --> 00:33:57,200
the higher reliability to be able to

920
00:34:00,149 --> 00:33:59,200
send humans deeper into

921
00:34:02,070 --> 00:34:00,159
mars

922
00:34:03,830 --> 00:34:02,080
go on to the next slide

923
00:34:06,389 --> 00:34:03,840
here's a few more investments in terms

924
00:34:08,310 --> 00:34:06,399
of mars resource utilization let me kind

925
00:34:11,829 --> 00:34:08,320
of leave you with this um

926
00:34:13,349 --> 00:34:11,839
uh thought wise um you know i spent most

927
00:34:15,109 --> 00:34:13,359
of my career at nasa langley in hampton

928
00:34:17,030 --> 00:34:15,119
virginia just

929
00:34:19,109 --> 00:34:17,040
south part of virginia

930
00:34:21,750 --> 00:34:19,119
jamestown settlement is just

931
00:34:24,149 --> 00:34:21,760
a handful of miles up the coast when the

932
00:34:25,349 --> 00:34:24,159
settlers came here uh maybe settlers

933
00:34:27,589 --> 00:34:25,359
weren't the right word but the explorers

934
00:34:29,909 --> 00:34:27,599
came here long ago um they brought what

935
00:34:31,909 --> 00:34:29,919
they needed to come to the new land

936
00:34:33,589 --> 00:34:31,919
just for the transit and then they lift

937
00:34:34,629 --> 00:34:33,599
off they lived off the land once they

938
00:34:36,389 --> 00:34:34,639

got here

939
00:34:37,990 --> 00:34:36,399
this is what we're trying to do with

940
00:34:40,790 --> 00:34:38,000
human missions to mars because if we if

941
00:34:43,190 --> 00:34:40,800
those uh ships the i had to bring

942
00:34:44,950 --> 00:34:43,200
everything there with them to live in

943
00:34:46,230 --> 00:34:44,960
the jamestown area

944
00:34:48,149 --> 00:34:46,240
that endeavor would have been so

945
00:34:50,470 --> 00:34:48,159
expensive and so large that would have

946
00:34:52,710 --> 00:34:50,480
made it very prohibitive for anyone to

947
00:34:54,310 --> 00:34:52,720
authorize to go you know and when we go

948
00:34:55,990 --> 00:34:54,320
to mars we have to bring the air with us

949
00:34:57,990 --> 00:34:56,000
too not just the water to drink or

950
00:34:59,589 --> 00:34:58,000
something like that and so we want to do

951
00:35:02,310 --> 00:34:59,599
something similar when we go with humans

952
00:35:04,230 --> 00:35:02,320
to mars where we utilize the atmosphere

953
00:35:06,069 --> 00:35:04,240
there on mars to be able to extract the

954
00:35:07,990 --> 00:35:06,079
oxygen from so that we don't have to

955
00:35:09,030 --> 00:35:08,000
bring all that oxygen with us so that we

956
00:35:10,950 --> 00:35:09,040
can use that to breathe for the

957
00:35:14,069 --> 00:35:10,960
astronauts we can make rocket fuel out

958
00:35:15,349 --> 00:35:14,079
of it uh freeze it uh so that it's

959
00:35:17,030 --> 00:35:15,359
liquid oxygen that we can use for

960
00:35:17,990 --> 00:35:17,040
propellant so that we can launch off the

961
00:35:20,470 --> 00:35:18,000
surface

962
00:35:21,990 --> 00:35:20,480
so we want to do move and explore in a

963
00:35:23,750 --> 00:35:22,000

very similar manner that we've done in

964
00:35:25,270 --> 00:35:23,760
the past so that we can live off the

965
00:35:27,750 --> 00:35:25,280
land to make all these missions very

966
00:35:28,870 --> 00:35:27,760
cost effective and more efficient to be

967
00:35:30,710 --> 00:35:28,880
able to

968
00:35:32,310 --> 00:35:30,720
conduct what we're trying to do which is

969
00:35:34,069 --> 00:35:32,320
explore mars

970
00:35:35,990 --> 00:35:34,079
in a much more

971
00:35:37,990 --> 00:35:36,000
aggressive manner so that we can

972
00:35:40,150 --> 00:35:38,000
actually really get a sense of are we

973
00:35:41,589 --> 00:35:40,160
alone in the universe

974
00:35:43,349 --> 00:35:41,599
we're making many other investments and

975
00:35:44,870 --> 00:35:43,359
those are just a few that i wanted to

976
00:35:46,630 --> 00:35:44,880
talk about right now and i'll be happy

977
00:35:48,470 --> 00:35:46,640
to take some questions

978
00:35:51,910 --> 00:35:48,480
let's take some questions on on

979
00:35:56,470 --> 00:35:53,990
here in the uh here in the front lauren

980
00:35:58,069 --> 00:35:56,480
i'm sorry in the go ahead

981
00:36:00,069 --> 00:35:58,079
hey so you were talking about using

982
00:36:02,470 --> 00:36:00,079
entry entry descent and landing for uh

983
00:36:04,069 --> 00:36:02,480
human exploration uh is there a physical

984
00:36:06,470 --> 00:36:04,079
limitation to the amount of mass you can

985
00:36:07,349 --> 00:36:06,480
bring uh to another planet with that uh

986
00:36:09,589 --> 00:36:07,359
so

987
00:36:12,069 --> 00:36:09,599
the only the only physical limitation is

988
00:36:14,230 --> 00:36:12,079

what our systems would be capable of

989
00:36:16,310 --> 00:36:14,240
either launching off the surface or once

990
00:36:17,670 --> 00:36:16,320
we get there being able to slow down and

991
00:36:20,230 --> 00:36:17,680
so it really comes down to what kind of

992
00:36:21,990 --> 00:36:20,240
system do you design um and right now

993
00:36:23,430 --> 00:36:22,000
we're limited to about one metric ton

994
00:36:25,510 --> 00:36:23,440
because of the type of technology we

995
00:36:27,349 --> 00:36:25,520
have to be able to land it and so if we

996
00:36:28,870 --> 00:36:27,359
improve that technology we'll be able to

997
00:36:30,550 --> 00:36:28,880
increase that

998
00:36:32,470 --> 00:36:30,560
payload to be able to get to the surface

999
00:36:33,670 --> 00:36:32,480
but there is no physics reason why we

1000
00:36:37,109 --> 00:36:33,680
can't land

1001
00:36:37,119 --> 00:36:41,430
can we go here to the front

1002
00:36:44,710 --> 00:36:43,270
what's the status of the laser

1003
00:36:46,150 --> 00:36:44,720
communication

1004
00:36:48,470 --> 00:36:46,160
technology that they're trying to use

1005
00:36:49,670 --> 00:36:48,480
from the space station

1006
00:36:52,630 --> 00:36:49,680
is it on

1007
00:36:55,030 --> 00:36:52,640
on track okay so so we have uh

1008
00:36:57,030 --> 00:36:55,040
a investment right now in our laser

1009
00:36:58,790 --> 00:36:57,040
communication to relay demonstration

1010
00:37:01,430 --> 00:36:58,800
where in a few years we're going to

1011
00:37:03,349 --> 00:37:01,440
demonstrate uh optical communications

1012
00:37:05,430 --> 00:37:03,359
from orbit down to the ground to be able

1013
00:37:08,790 --> 00:37:05,440

to get much higher speeds of bandwidth

1014
00:37:11,510 --> 00:37:08,800
there it is progressing very well um we

1015
00:37:12,870 --> 00:37:11,520
hope to by 2017 launch it and be able to

1016
00:37:13,670 --> 00:37:12,880
do that demonstration

1017
00:37:16,069 --> 00:37:13,680
um

1018
00:37:17,510 --> 00:37:16,079
we also are looking at deeper space uh

1019
00:37:19,430 --> 00:37:17,520
communications with that that's a low

1020
00:37:21,190 --> 00:37:19,440
earth orbit uh communication i shouldn't

1021
00:37:22,710 --> 00:37:21,200
say lower from zero synchronous orbit

1022
00:37:25,109 --> 00:37:22,720
orbit down to the ground so we'll be

1023
00:37:26,630 --> 00:37:25,119
able to do entire vicinity of the earth

1024
00:37:28,950 --> 00:37:26,640
we are trying to extend that to even

1025
00:37:30,790 --> 00:37:28,960
further deeper deep space activity and

1026
00:37:32,150 --> 00:37:30,800
so we have early investments in what it

1027
00:37:33,910 --> 00:37:32,160
would take to extend that capability

1028
00:37:35,349 --> 00:37:33,920
even further out in terms of into the

1029
00:37:37,750 --> 00:37:35,359
solar system and we're making those

1030
00:37:39,510 --> 00:37:37,760
investments now as well and so hopefully

1031
00:37:42,069 --> 00:37:39,520
in a few years we would be able to get a

1032
00:37:44,230 --> 00:37:42,079
optical system for communications for

1033
00:37:46,069 --> 00:37:44,240
not only nasa's use but for commercial

1034
00:37:47,829 --> 00:37:46,079
use where all those communication

1035
00:37:49,910 --> 00:37:47,839
satellites in geostationary orbit would

1036
00:37:52,870 --> 00:37:49,920
be able to provide that as a service to

1037
00:37:56,150 --> 00:37:52,880
everyone on the ground for uh much more

1038
00:37:58,470 --> 00:37:56,160

bandwidth capability than we we have now

1039
00:38:01,349 --> 00:37:58,480
let's go to social media for a question

1040
00:38:02,870 --> 00:38:01,359
sure so google plus user josh asks based

1041
00:38:04,630 --> 00:38:02,880
on what you have learned from curiosity

1042
00:38:06,550 --> 00:38:04,640
in the last year are there hardware

1043
00:38:08,069 --> 00:38:06,560
changes that you wish it possessed if

1044
00:38:12,390 --> 00:38:08,079
you had to rebuild curiosity from

1045
00:38:15,510 --> 00:38:13,990
how many hours does he have to talk

1046
00:38:17,589 --> 00:38:15,520
about no

1047
00:38:20,710 --> 00:38:17,599
entry descent and landing is a very

1048
00:38:22,310 --> 00:38:20,720
difficult endeavor just in aspect

1049
00:38:23,829 --> 00:38:22,320
one of the things that we call mars the

1050
00:38:26,150 --> 00:38:23,839
goldilocks plan

1051
00:38:28,150 --> 00:38:26,160
the reason being there is

1052
00:38:29,190 --> 00:38:28,160
not enough atmosphere to really help you

1053
00:38:30,550 --> 00:38:29,200
slow down

1054
00:38:32,390 --> 00:38:30,560
what you need like you do at earth when

1055
00:38:33,990 --> 00:38:32,400
you come down it slows us down so much

1056
00:38:36,630 --> 00:38:34,000
that it makes it much easier to land

1057
00:38:39,349 --> 00:38:36,640
heavier things on mars on earth than

1058
00:38:40,710 --> 00:38:39,359
mars but there's just enough atmosphere

1059
00:38:42,870 --> 00:38:40,720
that you have to worry about all these

1060
00:38:43,829 --> 00:38:42,880
other things uh if you land on the moon

1061
00:38:45,030 --> 00:38:43,839
you don't have to worry about thermal

1062
00:38:47,030 --> 00:38:45,040
protection systems because there's no

1063
00:38:49,670 --> 00:38:47,040

atmosphere you just propulsively come

1064
00:38:52,310 --> 00:38:49,680
down slow and land things and so

1065
00:38:55,030 --> 00:38:52,320
for curiosity um we're not going to make

1066
00:38:56,950 --> 00:38:55,040
any changes for the next uh landing that

1067
00:38:59,990 --> 00:38:56,960
uh the previous speaker talked about for

1068
00:39:02,550 --> 00:39:00,000
landing in 2020 the system worked great

1069
00:39:04,550 --> 00:39:02,560
we always have data that we get back

1070
00:39:06,550 --> 00:39:04,560
from there and we in fact had our heat

1071
00:39:08,150 --> 00:39:06,560
shield

1072
00:39:11,589 --> 00:39:08,160
on curiosity

1073
00:39:13,270 --> 00:39:11,599
instrumented with sensors that we are

1074
00:39:15,750 --> 00:39:13,280
downloading the data and analyzing it

1075
00:39:17,510 --> 00:39:15,760
right now on how everything went and

1076
00:39:19,430 --> 00:39:17,520
based on that we would make what we

1077
00:39:22,310 --> 00:39:19,440
think our best adjustments to that

1078
00:39:23,829 --> 00:39:22,320
before we do go on to the next landing

1079
00:39:25,030 --> 00:39:23,839
but everything we saw it worked very

1080
00:39:27,750 --> 00:39:25,040
well

1081
00:39:29,430 --> 00:39:27,760
i think we in one thing is we didn't use

1082
00:39:31,829 --> 00:39:29,440
as much fuel that we had put on the

1083
00:39:32,630 --> 00:39:31,839
system and so we can look at trades of

1084
00:39:34,390 --> 00:39:32,640
hey

1085
00:39:36,150 --> 00:39:34,400
since it went so well we could minimize

1086
00:39:37,349 --> 00:39:36,160
the fuel we put on there and add more

1087
00:39:39,270 --> 00:39:37,359
payload capability to put more

1088
00:39:40,710 --> 00:39:39,280

instruments to figure out on mars so we

1089
00:39:42,470 --> 00:39:40,720
would talk about those types of changes

1090
00:39:44,069 --> 00:39:42,480
but the system worked so well that i

1091
00:39:45,510 --> 00:39:44,079
don't believe we were going to do any

1092
00:39:47,190 --> 00:39:45,520
wholesale changes except some tweaks

1093
00:39:49,750 --> 00:39:47,200
here and there to just improve the

1094
00:39:51,829 --> 00:39:49,760
performance from where it was

1095
00:39:53,349 --> 00:39:51,839
okay please help me uh thank proson

1096
00:39:57,190 --> 00:39:53,359
desai everyone thank you

1097
00:40:00,710 --> 00:39:58,550
all right

1098
00:40:01,910 --> 00:40:00,720
we are closing in on our conversation

1099
00:40:04,310 --> 00:40:01,920
with the international space station

1100
00:40:06,310 --> 00:40:04,320
about 20 minutes from now which means

1101
00:40:07,589 --> 00:40:06,320
i don't know it'll travel a quarter of

1102
00:40:10,310 --> 00:40:07,599
the earth

1103
00:40:12,310 --> 00:40:10,320
in in orbit between now and then uh here

1104
00:40:13,510 --> 00:40:12,320
to help us understand a little bit more

1105
00:40:16,470 --> 00:40:13,520
about some of the research and

1106
00:40:19,990 --> 00:40:16,480
technology that's uh taking place above

1107
00:40:21,670 --> 00:40:20,000
our heads some 220 miles moving 17 500

1108
00:40:23,030 --> 00:40:21,680
miles an hour and orbiting the earth

1109
00:40:24,550 --> 00:40:23,040
every 90 minutes in a national

1110
00:40:27,270 --> 00:40:24,560
laboratory that's helping solve some of

1111
00:40:29,190 --> 00:40:27,280
these challenges that you just heard

1112
00:40:30,710 --> 00:40:29,200
the our next speaker actually directs

1113
00:40:32,630 --> 00:40:30,720

the international space station program

1114
00:40:40,150 --> 00:40:32,640
here at nasa headquarters in washington

1115
00:40:44,790 --> 00:40:41,589
thank you trent

1116
00:40:48,950 --> 00:40:46,790
well while one part of nasa has been

1117
00:40:50,390 --> 00:40:48,960
launching uh robots to mars and

1118
00:40:52,790 --> 00:40:50,400
exploring the service another part has

1119
00:40:55,270 --> 00:40:52,800
been launching people into space on to

1120
00:40:57,829 --> 00:40:55,280
the international space station

1121
00:40:59,589 --> 00:40:57,839
we are today and for several years now

1122
00:41:00,790 --> 00:40:59,599
and many years in the future are working

1123
00:41:02,870 --> 00:41:00,800
to send

1124
00:41:05,030 --> 00:41:02,880
to do the research and technology

1125
00:41:07,109 --> 00:41:05,040
demonstrations onboard space station to

1126
00:41:09,589 --> 00:41:07,119
get humans to mars

1127
00:41:12,309 --> 00:41:09,599
next slide please

1128
00:41:14,069 --> 00:41:12,319
well mike ask where we are today as far

1129
00:41:16,870 --> 00:41:14,079
as getting people out into space well

1130
00:41:19,670 --> 00:41:16,880
today the space station is about 400

1131
00:41:21,910 --> 00:41:19,680
kilometers away from earth it only takes

1132
00:41:23,670 --> 00:41:21,920
about six hours to two days transit time

1133
00:41:26,150 --> 00:41:23,680
to go back and forth and the

1134
00:41:27,990 --> 00:41:26,160
communications is near real time

1135
00:41:29,589 --> 00:41:28,000
and we have crew exchanges that go back

1136
00:41:30,630 --> 00:41:29,599
and forth every six months for the

1137
00:41:32,630 --> 00:41:30,640
station

1138
00:41:34,630 --> 00:41:32,640

and we have atmospheric samples and crew

1139
00:41:36,710 --> 00:41:34,640
samples that come back to earth that can

1140
00:41:39,030 --> 00:41:36,720
be analyzed to detect if the crew is

1141
00:41:40,550 --> 00:41:39,040
healthy the atmosphere is healthy our

1142
00:41:42,550 --> 00:41:40,560
research samples and the things of that

1143
00:41:44,230 --> 00:41:42,560
nature and we have supplies and

1144
00:41:46,630 --> 00:41:44,240
logistics that get launched to space

1145
00:41:49,030 --> 00:41:46,640
station that we can repair things and

1146
00:41:53,270 --> 00:41:49,040
get extra supplies up

1147
00:41:55,190 --> 00:41:53,280
we also have things as mundane as

1148
00:41:57,990 --> 00:41:55,200
removing trash from the space station

1149
00:41:59,910 --> 00:41:58,000
that burns up into the atmosphere and

1150
00:42:02,230 --> 00:41:59,920
most importantly is that we can return

1151
00:42:05,990 --> 00:42:02,240
the crew at practically any time to come

1152
00:42:07,670 --> 00:42:06,000
back in case of a on orbit anomaly or a

1153
00:42:09,670 --> 00:42:07,680
crew emergency

1154
00:42:11,829 --> 00:42:09,680
so what you're looking at today what we

1155
00:42:13,670 --> 00:42:11,839
have in space for our technology and our

1156
00:42:15,430 --> 00:42:13,680
knowledge we're basically just car

1157
00:42:17,349 --> 00:42:15,440
camping in space

1158
00:42:18,950 --> 00:42:17,359
if you've ever been car camping before

1159
00:42:21,589 --> 00:42:18,960
you take your car you build everything

1160
00:42:23,829 --> 00:42:21,599
up you need you that you need and you go

1161
00:42:26,470 --> 00:42:23,839
to a campsite if you get something you

1162
00:42:29,270 --> 00:42:26,480
go to walmart if you fall down and hurt

1163
00:42:31,190 --> 00:42:29,280

yourself you go to the hospital it's all

1164
00:42:33,349 --> 00:42:31,200
very convenient

1165
00:42:35,829 --> 00:42:33,359
next slide please

1166
00:42:38,470 --> 00:42:35,839
however mars isn't anything like that it

1167
00:42:41,430 --> 00:42:38,480
is completely different to go to mars we

1168
00:42:42,829 --> 00:42:41,440
have to build a capability and knowledge

1169
00:42:45,829 --> 00:42:42,839
to essentially

1170
00:42:47,349 --> 00:42:45,839
live on another earth to recreate a

1171
00:42:49,589 --> 00:42:47,359
capability what we just heard about

1172
00:42:51,430 --> 00:42:49,599
before in technology and the like to

1173
00:42:52,550 --> 00:42:51,440
provide our own atmospheres to remove

1174
00:42:54,790 --> 00:42:52,560
our trash

1175
00:42:57,270 --> 00:42:54,800
to be able to

1176
00:42:59,910 --> 00:42:57,280
keep the crew healthy all those things

1177
00:43:01,589 --> 00:42:59,920
has never been done before

1178
00:43:04,309 --> 00:43:01,599
neither here on earth has never been

1179
00:43:06,390 --> 00:43:04,319
recreated in an environment for such a

1180
00:43:07,670 --> 00:43:06,400
long period as mentioned before the

1181
00:43:10,150 --> 00:43:07,680
transit time

1182
00:43:11,910 --> 00:43:10,160
to going to mars is one to three years

1183
00:43:13,349 --> 00:43:11,920
to go back and forth and our

1184
00:43:15,670 --> 00:43:13,359
communication

1185
00:43:18,309 --> 00:43:15,680
when we get to mars is up to 42 minutes

1186
00:43:20,069 --> 00:43:18,319
round trip there is no link between

1187
00:43:23,190 --> 00:43:20,079
earth and mars other than the

1188
00:43:25,510 --> 00:43:23,200

communications so on space station today

1189
00:43:27,589 --> 00:43:25,520
we are learning how to break all those

1190
00:43:30,069 --> 00:43:27,599
links not only just how to keep the crew

1191
00:43:32,230 --> 00:43:30,079
alive and healthy and productive but to

1192
00:43:33,990 --> 00:43:32,240
break all the logistics chain

1193
00:43:35,829 --> 00:43:34,000
break all the uh

1194
00:43:37,589 --> 00:43:35,839
uh logistics the delicious this has

1195
00:43:40,309 --> 00:43:37,599
changed the capability to return the

1196
00:43:42,230 --> 00:43:40,319
crew safely when we're going on to mars

1197
00:43:44,710 --> 00:43:42,240
and once you

1198
00:43:46,069 --> 00:43:44,720
pass a certain point you can't get back

1199
00:43:48,230 --> 00:43:46,079
to earth

1200
00:43:50,309 --> 00:43:48,240
uh easily you have to actually go all

1201
00:43:52,309 --> 00:43:50,319
the way there and then come back and

1202
00:43:54,710 --> 00:43:52,319
then you've got orbital dynamics to take

1203
00:43:57,430 --> 00:43:54,720
to consider you can't come back just at

1204
00:43:58,950 --> 00:43:57,440
any time only predetermined times

1205
00:44:01,109 --> 00:43:58,960
so what are we doing on space station

1206
00:44:02,470 --> 00:44:01,119
today next slide

1207
00:44:04,230 --> 00:44:02,480
we're doing a whole lot of things and

1208
00:44:05,829 --> 00:44:04,240
i'm just going to only highlight a few

1209
00:44:08,710 --> 00:44:05,839
of them here

1210
00:44:10,950 --> 00:44:08,720
first is the duration today our crews

1211
00:44:13,030 --> 00:44:10,960
are rotated every six months on space

1212
00:44:14,710 --> 00:44:13,040
station and we have uh

1213
00:44:16,870 --> 00:44:14,720

in our research and our crew health is

1214
00:44:19,270 --> 00:44:16,880
all based on six months

1215
00:44:20,630 --> 00:44:19,280
uh time frame but to send people to mars

1216
00:44:22,710 --> 00:44:20,640
it's going to take at least a year to

1217
00:44:25,270 --> 00:44:22,720
get there and back so we need to be able

1218
00:44:26,790 --> 00:44:25,280
to understand the effects of weightless

1219
00:44:29,829 --> 00:44:26,800
weightlessness and radiation on the

1220
00:44:32,550 --> 00:44:29,839
human body so starting in 2015 we'll

1221
00:44:35,430 --> 00:44:32,560
start our first one-year crew increment

1222
00:44:39,109 --> 00:44:35,440
to understand the effects of bone loss

1223
00:44:42,870 --> 00:44:39,119
and muscle loss on on on longer periods

1224
00:44:44,069 --> 00:44:42,880
also in our on ocular vision we've

1225
00:44:46,150 --> 00:44:44,079
had some

1226
00:44:47,670 --> 00:44:46,160
issues with ocular vision on on the

1227
00:44:49,750 --> 00:44:47,680
astronauts that have been on board space

1228
00:44:52,309 --> 00:44:49,760
station for six months so learning how

1229
00:44:53,109 --> 00:44:52,319
to do that to keep the crew healthy uh

1230
00:44:54,790 --> 00:44:53,119
and

1231
00:44:56,630 --> 00:44:54,800
to keep them uh

1232
00:44:58,150 --> 00:44:56,640
psychologically healthy and things of

1233
00:45:00,630 --> 00:44:58,160
that nature we're gonna try that for the

1234
00:45:01,670 --> 00:45:00,640
first time in 2015 for a one-year crew

1235
00:45:04,870 --> 00:45:01,680
increment

1236
00:45:06,790 --> 00:45:04,880
starting on the right side

1237
00:45:08,309 --> 00:45:06,800
is the second most important thing is

1238
00:45:10,790 --> 00:45:08,319

environmental control and monitoring

1239
00:45:13,349 --> 00:45:10,800
system today it takes a lot of

1240
00:45:15,750 --> 00:45:13,359
maintenance and a lot of crew time and

1241
00:45:17,190 --> 00:45:15,760
ground time to keep the environmental

1242
00:45:19,589 --> 00:45:17,200
control and life support system

1243
00:45:22,069 --> 00:45:19,599
functioning properly we are making

1244
00:45:24,790 --> 00:45:22,079
modifications to the system today to

1245
00:45:25,750 --> 00:45:24,800
increase its reliability and performance

1246
00:45:27,750 --> 00:45:25,760
and

1247
00:45:29,910 --> 00:45:27,760
in the next few years we hope to have

1248
00:45:31,990 --> 00:45:29,920
the marsh system for e for the

1249
00:45:34,309 --> 00:45:32,000
environmental control system on station

1250
00:45:37,670 --> 00:45:34,319
operating and it'll be that system that

1251
00:45:39,430 --> 00:45:37,680
we fly on on the iss that we take to the

1252
00:45:40,790 --> 00:45:39,440
mark to mars

1253
00:45:43,109 --> 00:45:40,800
down from there is the crew health and

1254
00:45:44,950 --> 00:45:43,119
monitoring equipment a couple slides

1255
00:45:47,430 --> 00:45:44,960
back you saw that we have all the crew

1256
00:45:49,270 --> 00:45:47,440
samples and air samples that come back

1257
00:45:51,109 --> 00:45:49,280
as far as you know blood and urine and

1258
00:45:52,390 --> 00:45:51,119
water and the like to see if this if the

1259
00:45:55,349 --> 00:45:52,400
crew is healthy the systems are

1260
00:45:57,109 --> 00:45:55,359
performing correctly when we go to mars

1261
00:45:59,910 --> 00:45:57,119
we can't do that all that has to be

1262
00:46:03,990 --> 00:45:59,920
characterized on or on orbit with the

1263
00:46:06,309 --> 00:46:04,000

crew uh assistance and determining uh

1264
00:46:08,950 --> 00:46:06,319
is is that is all the performance

1265
00:46:12,069 --> 00:46:08,960
parameters in its normal ranges

1266
00:46:14,630 --> 00:46:12,079
uh going on to the top uh left on your

1267
00:46:17,829 --> 00:46:14,640
side is the exercise equipment today our

1268
00:46:19,829 --> 00:46:17,839
x is our size equipment is large it has

1269
00:46:22,230 --> 00:46:19,839
lots of moving parts it's they're

1270
00:46:24,950 --> 00:46:22,240
complex and they have take up a lot of

1271
00:46:26,950 --> 00:46:24,960
mass and space going to mars all this

1272
00:46:29,430 --> 00:46:26,960
will have to be a lot smaller than it is

1273
00:46:31,270 --> 00:46:29,440
today so we're making improvements and

1274
00:46:32,470 --> 00:46:31,280
flying additional equipment onboard the

1275
00:46:33,190 --> 00:46:32,480
station

1276
00:46:35,109 --> 00:46:33,200
to

1277
00:46:37,430 --> 00:46:35,119
ensure that the crew has

1278
00:46:39,190 --> 00:46:37,440
has functioning equipment

1279
00:46:41,670 --> 00:46:39,200
to go to mars with

1280
00:46:43,190 --> 00:46:41,680
we also have onboard water analyzers

1281
00:46:45,510 --> 00:46:43,200
again to

1282
00:46:46,710 --> 00:46:45,520
break the chain of bringing samples back

1283
00:46:49,510 --> 00:46:46,720
to earth

1284
00:46:51,349 --> 00:46:49,520
and one of the other things not not the

1285
00:46:53,510 --> 00:46:51,359
last one but

1286
00:46:56,230 --> 00:46:53,520
one that we're working on right now is

1287
00:46:58,309 --> 00:46:56,240
the new exploration suit demonstration

1288
00:47:00,870 --> 00:46:58,319

uh today our suits

1289
00:47:02,950 --> 00:47:00,880
we have today on space station are 1980s

1290
00:47:05,510 --> 00:47:02,960
vintage uh

1291
00:47:06,950 --> 00:47:05,520
technology so we're working across nasa

1292
00:47:09,030 --> 00:47:06,960
to

1293
00:47:10,550 --> 00:47:09,040
build a new suit and demonstrate it on

1294
00:47:11,910 --> 00:47:10,560
on space station

1295
00:47:13,829 --> 00:47:11,920
so these are just some of the things

1296
00:47:18,150 --> 00:47:13,839
we're doing on space station today to

1297
00:47:19,990 --> 00:47:18,160
get us to mars and with that i'd um open

1298
00:47:21,109 --> 00:47:20,000
up the questions

1299
00:47:22,390 --> 00:47:21,119
thanks i just want to remind the

1300
00:47:23,910 --> 00:47:22,400
audience that's joining us online that

1301
00:47:25,829 --> 00:47:23,920
you can ask questions of our speakers

1302
00:47:28,470 --> 00:47:25,839
and then pretty soon here the crew using

1303
00:47:29,910 --> 00:47:28,480
the hashtag asknasa on twitter and

1304
00:47:31,750 --> 00:47:29,920
google plus i actually want to take

1305
00:47:33,589 --> 00:47:31,760
podium privilege real quick sam and just

1306
00:47:37,030 --> 00:47:33,599
ask a question it's because jim showed

1307
00:47:39,190 --> 00:47:37,040
this really incredible picture um that

1308
00:47:40,390 --> 00:47:39,200
that fan made image of uh someone in a

1309
00:47:42,710 --> 00:47:40,400
spacesuit

1310
00:47:44,309 --> 00:47:42,720
uh or at least a giant robot standing

1311
00:47:46,470 --> 00:47:44,319
next to curiosity i know there's some

1312
00:47:48,390 --> 00:47:46,480
robotics happening on station two and we

1313
00:47:50,150 --> 00:47:48,400

sometimes talk about how humans and

1314
00:47:51,589 --> 00:47:50,160
robots will be working together to

1315
00:47:53,190 --> 00:47:51,599
accomplish these things can you tell us

1316
00:47:54,309 --> 00:47:53,200
some of the some of the robotic

1317
00:47:56,230 --> 00:47:54,319
experiments that are happening on the

1318
00:47:58,550 --> 00:47:56,240
station right now and you know who the

1319
00:48:01,190 --> 00:47:58,560
robots are that are up there well

1320
00:48:02,790 --> 00:48:01,200
let's see how many robots do we have so

1321
00:48:04,710 --> 00:48:02,800
i'm familiar with at least three three

1322
00:48:07,750 --> 00:48:04,720
of the robots that are on station and

1323
00:48:09,109 --> 00:48:07,760
one that's on on its way

1324
00:48:11,829 --> 00:48:09,119
first two that have been there a long

1325
00:48:13,030 --> 00:48:11,839
time is the canadian arm and the

1326
00:48:15,510 --> 00:48:13,040
canadian

1327
00:48:18,710 --> 00:48:15,520
dexter manipulator system these two

1328
00:48:21,270 --> 00:48:18,720
large robots are basically industrial

1329
00:48:24,069 --> 00:48:21,280
robots and we've learned a lot about

1330
00:48:26,150 --> 00:48:24,079
assembling pieces in space how to do

1331
00:48:28,390 --> 00:48:26,160
ground control

1332
00:48:32,870 --> 00:48:28,400
how to do maintenance and things of that

1333
00:48:34,710 --> 00:48:32,880
nature we also have a third robot inside

1334
00:48:36,950 --> 00:48:34,720
it's actually half of a robot called

1335
00:48:38,790 --> 00:48:36,960
robonaut doesn't have legs yet

1336
00:48:41,270 --> 00:48:38,800
and we're learning how on board space

1337
00:48:43,670 --> 00:48:41,280
station to integrate

1338
00:48:46,470 --> 00:48:43,680

a robot activities together in close

1339
00:48:48,790 --> 00:48:46,480
proximity to human activities

1340
00:48:51,030 --> 00:48:48,800
so that's very important to us as well

1341
00:48:54,470 --> 00:48:51,040
and i think the the fourth one that just

1342
00:48:56,309 --> 00:48:54,480
was launched on htv from japan is uh i

1343
00:48:59,109 --> 00:48:56,319
think the japanese are characterizing it

1344
00:49:00,950 --> 00:48:59,119
as a astronaut friend robot it's a it's

1345
00:49:03,829 --> 00:49:00,960
a small smaller robot that that

1346
00:49:05,910 --> 00:49:03,839
interacts verbally uh with with the crew

1347
00:49:07,349 --> 00:49:05,920
member and if i'm not mistaken didn't we

1348
00:49:09,270 --> 00:49:07,359
recently have some crew members actually

1349
00:49:11,910 --> 00:49:09,280
drive something not too dissimilar and

1350
00:49:14,470 --> 00:49:11,920
we also have stations uh uh remote

1351
00:49:17,430 --> 00:49:14,480
controlled a robot and at the ames

1352
00:49:19,910 --> 00:49:17,440
research center uh that from the crew on

1353
00:49:23,589 --> 00:49:19,920
board the space station uh to simulate

1354
00:49:25,990 --> 00:49:23,599
actually uh driving uh space uh robots

1355
00:49:29,030 --> 00:49:26,000
from an orbiting spacecraft uh around

1356
00:49:31,190 --> 00:49:29,040
the moon or actually mars

1357
00:49:32,230 --> 00:49:31,200
as well i i geeked out about that quite

1358
00:49:33,670 --> 00:49:32,240
honestly just growing up with remote

1359
00:49:35,270 --> 00:49:33,680
control cars seeing astronaut drive

1360
00:49:36,390 --> 00:49:35,280
something on earth was free mind-blowing

1361
00:49:37,670 --> 00:49:36,400
we have any questions in the audience

1362
00:49:40,790 --> 00:49:37,680
right here

1363
00:49:43,190 --> 00:49:40,800

um yes these uh robots and robotics

1364
00:49:46,549 --> 00:49:43,200
they're so uh capable

1365
00:49:47,910 --> 00:49:46,559
and what is the real advantage of having

1366
00:49:49,190 --> 00:49:47,920
a person

1367
00:49:51,349 --> 00:49:49,200
on

1368
00:49:53,109 --> 00:49:51,359
these uh foreign

1369
00:49:54,710 --> 00:49:53,119
terrestrial places rather than just

1370
00:49:57,270 --> 00:49:54,720
sending so many

1371
00:49:59,990 --> 00:49:57,280
leaner easier to get to

1372
00:50:03,589 --> 00:50:00,000
more efficient robotics to the

1373
00:50:05,829 --> 00:50:03,599
mars and beyond uh if you if you compare

1374
00:50:08,069 --> 00:50:05,839
what it takes to plan and operate a

1375
00:50:10,390 --> 00:50:08,079
robot long distances like

1376
00:50:11,349 --> 00:50:10,400
from earth to mars and what a human can

1377
00:50:15,349 --> 00:50:11,359
do

1378
00:50:18,309 --> 00:50:15,359
it takes a year or more for what a robot

1379
00:50:19,750 --> 00:50:18,319
can do that a person can do in a matter

1380
00:50:21,270 --> 00:50:19,760
of days

1381
00:50:24,549 --> 00:50:21,280
so one is

1382
00:50:26,470 --> 00:50:24,559
efficiency is that the crew member can

1383
00:50:28,630 --> 00:50:26,480
do things a lot quicker than a robot can

1384
00:50:30,470 --> 00:50:28,640
because it all has to be pre-planned and

1385
00:50:33,030 --> 00:50:30,480
with the communications lag between us

1386
00:50:35,990 --> 00:50:33,040
and and mars that's a real that's a real

1387
00:50:37,670 --> 00:50:36,000
handicap uh the second biggest thing and

1388
00:50:40,470 --> 00:50:37,680

i think more important is you have an

1389
00:50:43,109 --> 00:50:40,480
intel an intelligent being interpreting

1390
00:50:46,069 --> 00:50:43,119
its environment a crew can

1391
00:50:48,470 --> 00:50:46,079
immediately pick up is this important is

1392
00:50:51,109 --> 00:50:48,480
that that's not important and if they're

1393
00:50:53,349 --> 00:50:51,119
trained as a geologist they can

1394
00:50:55,270 --> 00:50:53,359
pick up the right rock or not the right

1395
00:50:57,109 --> 00:50:55,280
rock so that's another advantage of

1396
00:50:59,510 --> 00:50:57,119
having the crew members and i think

1397
00:51:01,829 --> 00:50:59,520
thirdly there's a uh there's a societal

1398
00:51:04,309 --> 00:51:01,839
benefit as well to having uh people

1399
00:51:06,870 --> 00:51:04,319
involved uh in in

1400
00:51:08,950 --> 00:51:06,880
exploration i don't know anybody any

1401
00:51:10,630 --> 00:51:08,960
kids that want to grow up to be a robot

1402
00:51:11,670 --> 00:51:10,640
or to be a rocket

1403
00:51:13,190 --> 00:51:11,680
um

1404
00:51:15,109 --> 00:51:13,200
they all want to grow up to be an

1405
00:51:18,069 --> 00:51:15,119
astronaut or be a scientist or an

1406
00:51:20,549 --> 00:51:18,079
engineer uh no one's actually advocating

1407
00:51:25,190 --> 00:51:20,559
for people to be robot so

1408
00:51:27,670 --> 00:51:26,630
so let's take a question from social

1409
00:51:28,950 --> 00:51:27,680
media

1410
00:51:31,349 --> 00:51:28,960
sure we have a question here from

1411
00:51:33,750 --> 00:51:31,359
twitter user lucy whitehead there are

1412
00:51:36,710 --> 00:51:33,760
plans to put people on mars but is there

1413
00:51:38,309 --> 00:51:36,720

the possibility of people living on mars

1414
00:51:39,829 --> 00:51:38,319
yes i think at some point in time once

1415
00:51:40,870 --> 00:51:39,839
we've learned to travel there and come

1416
00:51:43,190 --> 00:51:40,880
back

1417
00:51:44,870 --> 00:51:43,200
and to be able to use the resources

1418
00:51:47,510 --> 00:51:44,880
on the martian surface i think it one

1419
00:51:49,430 --> 00:51:47,520
day will be possible

1420
00:51:56,069 --> 00:51:49,440
okay more questions in the audience

1421
00:52:01,349 --> 00:51:58,390
so uh if i'm not mistaken

1422
00:52:03,349 --> 00:52:01,359
this is just as a backstory the faa has

1423
00:52:05,589 --> 00:52:03,359
ramped up

1424
00:52:06,870 --> 00:52:05,599
pilot requirements to do more manual

1425
00:52:09,270 --> 00:52:06,880
flying because there's been a lot of

1426
00:52:11,670 --> 00:52:09,280
concern about over automation too much

1427
00:52:13,430 --> 00:52:11,680
reliance on systems like that

1428
00:52:16,069 --> 00:52:13,440
uh is there any concern about that with

1429
00:52:18,390 --> 00:52:16,079
nasa that we would ever get too reliant

1430
00:52:19,109 --> 00:52:18,400
on these these automated systems like

1431
00:52:27,349 --> 00:52:19,119
the

1432
00:52:28,309 --> 00:52:27,359
of if you will crew control space flight

1433
00:52:29,910 --> 00:52:28,319
uh

1434
00:52:31,430 --> 00:52:29,920
on the way up from the ground right

1435
00:52:33,750 --> 00:52:31,440
while riding on the rocket there's not a

1436
00:52:36,230 --> 00:52:33,760
lot the crew can actually do other than

1437
00:52:37,750 --> 00:52:36,240
get off the rocket if it's if something

1438
00:52:39,910 --> 00:52:37,760

goes wrong

1439
00:52:42,230 --> 00:52:39,920
however in space

1440
00:52:44,230 --> 00:52:42,240
there's always the capability for the

1441
00:52:45,990 --> 00:52:44,240
crew member to override any automated

1442
00:52:48,069 --> 00:52:46,000
system and the way we the way we've

1443
00:52:49,910 --> 00:52:48,079
designed systems in the past and the way

1444
00:52:52,150 --> 00:52:49,920
we're designing them in the future

1445
00:52:53,510 --> 00:52:52,160
there are some tasks that are better

1446
00:52:55,910 --> 00:52:53,520
left as the first

1447
00:52:58,309 --> 00:52:55,920
first level of control as automation

1448
00:52:59,910 --> 00:52:58,319
like automated rendezvous and docking

1449
00:53:02,069 --> 00:52:59,920
it's a lot more efficient that way but

1450
00:53:03,670 --> 00:53:02,079
the crew is always monitoring and able

1451
00:53:05,109 --> 00:53:03,680
to back out of the system in case

1452
00:53:07,030 --> 00:53:05,119
something something's wrong so i don't

1453
00:53:08,069 --> 00:53:07,040
think it's an either or it just comes

1454
00:53:10,230 --> 00:53:08,079
down to

1455
00:53:12,549 --> 00:53:10,240
what is more efficient and more uh

1456
00:53:15,190 --> 00:53:12,559
repeatable and reliable and but always

1457
00:53:17,349 --> 00:53:15,200
having the crew ability to back out of

1458
00:53:19,990 --> 00:53:17,359
it in in case the automated system uh

1459
00:53:21,030 --> 00:53:20,000
does not perform as expected

1460
00:53:23,030 --> 00:53:21,040
you know sam one of the one of the

1461
00:53:24,710 --> 00:53:23,040
things that our tv crew has is a really

1462
00:53:26,309 --> 00:53:24,720
nice image of the international space

1463
00:53:27,990 --> 00:53:26,319

station and i think some people sort of

1464
00:53:29,589 --> 00:53:28,000
forget you know we don't see it all all

1465
00:53:31,510 --> 00:53:29,599
that often in fact this almost looks

1466
00:53:33,750 --> 00:53:31,520
like a live view um

1467
00:53:35,750 --> 00:53:33,760
what you know the sheer size and scope

1468
00:53:36,870 --> 00:53:35,760
of of what this laboratory is maybe you

1469
00:53:38,950 --> 00:53:36,880
can

1470
00:53:39,910 --> 00:53:38,960
it's it's a live picture i'm being told

1471
00:53:41,829 --> 00:53:39,920
can you can you tell us what we're

1472
00:53:44,549 --> 00:53:41,839
looking at here as we get ready we're

1473
00:53:47,349 --> 00:53:44,559
looking at the appendage that you're

1474
00:53:50,790 --> 00:53:47,359
seeing there sticking up is the

1475
00:53:53,589 --> 00:53:50,800
canadian arm and you're seeing in in the

1476
00:53:55,990 --> 00:53:53,599
forefront the columbus module with its

1477
00:53:58,150 --> 00:53:56,000
exposed facilities

1478
00:53:59,990 --> 00:53:58,160
you also see the golden solar arrays

1479
00:54:02,950 --> 00:54:00,000
sticking through at the bottom

1480
00:54:03,990 --> 00:54:02,960
the u.s lab in the midsection there

1481
00:54:05,190 --> 00:54:04,000
and

1482
00:54:06,950 --> 00:54:05,200
of course the

1483
00:54:08,950 --> 00:54:06,960
earth above

1484
00:54:10,390 --> 00:54:08,960
the space station itself is as large as

1485
00:54:13,750 --> 00:54:10,400
a football field

1486
00:54:16,230 --> 00:54:13,760
and about a million pounds uh it's it's

1487
00:54:18,309 --> 00:54:16,240
unfortunate that the space station never

1488
00:54:20,390 --> 00:54:18,319

comes back people don't actually get a

1489
00:54:22,870 --> 00:54:20,400
chance to see it like the shuttle

1490
00:54:25,910 --> 00:54:22,880
comes back the when we have when we fly

1491
00:54:28,069 --> 00:54:25,920
uh the soyuz or the the the dragon

1492
00:54:30,549 --> 00:54:28,079
vehicle it all comes back so you can

1493
00:54:32,790 --> 00:54:30,559
actually see it and and you know hear it

1494
00:54:34,710 --> 00:54:32,800
feel it touch it uh space station you

1495
00:54:38,230 --> 00:54:34,720
just can't you can see it uh when it

1496
00:54:40,549 --> 00:54:38,240
passes over um and uh do a little plug

1497
00:54:42,790 --> 00:54:40,559
for spot the station app to find space

1498
00:54:45,510 --> 00:54:42,800
station wherever you're located uh but

1499
00:54:47,589 --> 00:54:45,520
it's uh it's an amazing facility uh it

1500
00:54:50,630 --> 00:54:47,599
took many years and many uh flights to

1501
00:54:51,670 --> 00:54:50,640
get it assembled and uh

1502
00:54:53,470 --> 00:54:51,680
that's it

1503
00:54:55,750 --> 00:54:53,480
no that's a good point uh spot the

1504
00:54:57,349 --> 00:54:55,760
station.nasa.gov is where you can go uh

1505
00:54:59,510 --> 00:54:57,359
to find out where the international

1506
00:55:01,349 --> 00:54:59,520
space station passes it's i think it's

1507
00:55:03,430 --> 00:55:01,359
pretty much the brightest uh image or

1508
00:55:05,430 --> 00:55:03,440
brightest um a point of light in the sky

1509
00:55:07,750 --> 00:55:05,440
when you see it except for the sun and

1510
00:55:09,670 --> 00:55:07,760
the moon yeah and it it moves quick but

1511
00:55:11,589 --> 00:55:09,680
when you can catch it it's uh it's very

1512
00:55:12,870 --> 00:55:11,599
very cool to see let's go back to social

1513
00:55:13,990 --> 00:55:12,880

media for a question then i'll check in

1514
00:55:15,190 --> 00:55:14,000
the audience

1515
00:55:18,150 --> 00:55:15,200
sure we've got a question here from

1516
00:55:20,630 --> 00:55:18,160
twitter user genejm29

1517
00:55:22,470 --> 00:55:20,640
since current eva suits are 80s vintage

1518
00:55:23,910 --> 00:55:22,480
what is in development now and how long

1519
00:55:25,109 --> 00:55:23,920
will it be before those suits become

1520
00:55:26,950 --> 00:55:25,119
available

1521
00:55:29,030 --> 00:55:26,960
well right now we have technology

1522
00:55:30,630 --> 00:55:29,040
development activities going on today

1523
00:55:32,549 --> 00:55:30,640
between

1524
00:55:34,150 --> 00:55:32,559
the human exploration

1525
00:55:36,150 --> 00:55:34,160
and operations mission directorate and

1526
00:55:39,589 --> 00:55:36,160
the space technology mission directorate

1527
00:55:41,270 --> 00:55:39,599
uh to develop the uh newer generations

1528
00:55:44,150 --> 00:55:41,280
uh of

1529
00:55:47,270 --> 00:55:44,160
of scrubbers of of the life support

1530
00:55:51,109 --> 00:55:47,280
system uh new materials for the suit

1531
00:55:53,750 --> 00:55:51,119
today our suit is a uh a multi-part suit

1532
00:55:56,230 --> 00:55:53,760
i would say and our next generation suit

1533
00:55:58,309 --> 00:55:56,240
will be more uh like the or the russian

1534
00:55:59,829 --> 00:55:58,319
orlan suit where it's more or less one

1535
00:56:01,349 --> 00:55:59,839
piece and the crew steps in from the

1536
00:56:03,990 --> 00:56:01,359
back

1537
00:56:06,309 --> 00:56:04,000
there's a picture of it right now

1538
00:56:08,390 --> 00:56:06,319

the suit will look similar for you know

1539
00:56:10,870 --> 00:56:08,400
just for the casual observer but the

1540
00:56:13,109 --> 00:56:10,880
internal functions uh will be completely

1541
00:56:17,030 --> 00:56:13,119
uh updated with newer technology and

1542
00:56:18,789 --> 00:56:17,040
it'll be a more compact suit as well

1543
00:56:22,069 --> 00:56:18,799
great questions in the audience

1544
00:56:24,230 --> 00:56:22,079
international space station in the front

1545
00:56:27,670 --> 00:56:24,240
does nasa have a view on private

1546
00:56:30,630 --> 00:56:27,680
initiatives like the mars one initiative

1547
00:56:34,349 --> 00:56:30,640
uh nasa is is support is supportive of

1548
00:56:36,789 --> 00:56:34,359
the private initiatives um the ins

1549
00:56:38,630 --> 00:56:36,799
inspiration mars i think that's that's

1550
00:56:41,750 --> 00:56:38,640
the the reason when that that was

1551
00:56:44,230 --> 00:56:41,760
announced uh we're working uh with them

1552
00:56:46,309 --> 00:56:44,240
to understand what their mission is and

1553
00:56:48,069 --> 00:56:46,319
and what help they might need from nasa

1554
00:56:49,030 --> 00:56:48,079
so we're very supportive of such

1555
00:56:51,270 --> 00:56:49,040
missions

1556
00:56:54,789 --> 00:56:51,280
i don't know if we're

1557
00:56:57,910 --> 00:56:54,799
uh actively promoting one-way

1558
00:56:59,829 --> 00:56:57,920
missions to mars as nasa's is in in the

1559
00:57:02,710 --> 00:56:59,839
two-way business

1560
00:57:05,030 --> 00:57:02,720
uh but we we are we are very supportive

1561
00:57:06,710 --> 00:57:05,040
private private initiatives we like our

1562
00:57:08,470 --> 00:57:06,720
astronauts to come home and in the last

1563
00:57:10,870 --> 00:57:08,480

couple of minutes uh that we have with

1564
00:57:12,789 --> 00:57:10,880
you uh could you explain on that note on

1565
00:57:14,309 --> 00:57:12,799
commercial space kind of where we are in

1566
00:57:16,470 --> 00:57:14,319
development of the new spacecraft to

1567
00:57:19,109 --> 00:57:16,480
take us astronauts you know once again

1568
00:57:20,710 --> 00:57:19,119
from u.s soil uh i think they're there

1569
00:57:22,789 --> 00:57:20,720
and people may be familiar with a couple

1570
00:57:24,069 --> 00:57:22,799
of the cargo craft that came if you can

1571
00:57:25,109 --> 00:57:24,079
talk a little bit about how how the

1572
00:57:26,789 --> 00:57:25,119
space station is working on the

1573
00:57:29,270 --> 00:57:26,799
commercial side in american voting well

1574
00:57:30,870 --> 00:57:29,280
there's uh two aspects to the commercial

1575
00:57:33,670 --> 00:57:30,880
uh uh

1576
00:57:35,670 --> 00:57:33,680
involvement uh in in space on space

1577
00:57:39,109 --> 00:57:35,680
station and also i'd like to say just

1578
00:57:41,510 --> 00:57:39,119
more in private initiative in general uh

1579
00:57:42,870 --> 00:57:41,520
as you as many of you may know we have a

1580
00:57:47,510 --> 00:57:42,880
uh

1581
00:57:49,990 --> 00:57:47,520
orbital to provide cargo to the space

1582
00:57:51,349 --> 00:57:50,000
station but we're also in development uh

1583
00:57:52,789 --> 00:57:51,359
with

1584
00:57:54,710 --> 00:57:52,799
other industry

1585
00:57:57,190 --> 00:57:54,720
partners to develop the commercial crew

1586
00:57:59,990 --> 00:57:57,200
car uh capability

1587
00:58:02,789 --> 00:58:00,000
to space station uh with spacex uh

1588
00:58:04,150 --> 00:58:02,799

boeing and sierra nevada

1589
00:58:06,950 --> 00:58:04,160
but also that's only part of the

1590
00:58:10,230 --> 00:58:06,960
commercial initiative on board station

1591
00:58:12,950 --> 00:58:10,240
we are have a partnership with cases

1592
00:58:15,510 --> 00:58:12,960
which is a the national lab developer

1593
00:58:18,150 --> 00:58:15,520
for for nasa uh onboard the space

1594
00:58:20,390 --> 00:58:18,160
station uh cases is working with private

1595
00:58:23,349 --> 00:58:20,400
industry to utilize space station for

1596
00:58:26,710 --> 00:58:23,359
things like pharmaceutical research or

1597
00:58:29,430 --> 00:58:26,720
materials research like colloids

1598
00:58:31,670 --> 00:58:29,440
new medical devices and the like so our

1599
00:58:34,549 --> 00:58:31,680
commercial environment

1600
00:58:37,349 --> 00:58:34,559
involvement is uh is quite broad for on

1601
00:58:38,470 --> 00:58:37,359
on space station so and real fast is

1602
00:58:39,990 --> 00:58:38,480
there anything that we just recently

1603
00:58:41,910 --> 00:58:40,000
sent up to the crew that you thought was

1604
00:58:43,349 --> 00:58:41,920
particularly cool any home packages or

1605
00:58:44,870 --> 00:58:43,359
care package or anything like that well

1606
00:58:46,789 --> 00:58:44,880
you know fresh food and ice cream is

1607
00:58:48,390 --> 00:58:46,799
always good stuff

1608
00:58:49,670 --> 00:58:48,400
we'll see if we can get a question or

1609
00:58:51,270 --> 00:58:49,680
two about that

1610
00:58:58,630 --> 00:58:51,280
help me uh help me everyone please uh

1611
00:59:01,910 --> 00:58:59,829
very good

1612
00:59:04,390 --> 00:59:01,920
and we are now looking at a picture of

1613
00:59:05,829 --> 00:59:04,400

mission control in houston which helps

1614
00:59:07,829 --> 00:59:05,839
manage the international space station

1615
00:59:09,349 --> 00:59:07,839
program i understand let me just pause

1616
00:59:11,670 --> 00:59:09,359
for a second that we are very close to

1617
00:59:14,069 --> 00:59:11,680
being able to talk to chris cassidy and

1618
00:59:15,349 --> 00:59:14,079
karen nyberg who are the two american

1619
00:59:18,950 --> 00:59:15,359
crew members aboard the international

1620
00:59:19,750 --> 00:59:18,960
space station of the expedition 36 crew

1621
00:59:22,789 --> 00:59:19,760
so

1622
00:59:25,510 --> 00:59:22,799
let me start by asking the station

1623
00:59:28,549 --> 00:59:25,520
station this is nasa headquarters how do

1624
00:59:32,390 --> 00:59:30,230
houston this is station we are ready for

1625
00:59:34,150 --> 00:59:32,400
the event thank you so much for joining

1626
00:59:37,030 --> 00:59:34,160
us chris and karen it's wonderful to see

1627
00:59:39,750 --> 00:59:37,829
all right

1628
00:59:41,349 --> 00:59:39,760
so we're we're here in washington in the

1629
00:59:43,510 --> 00:59:41,359
nasa headquarters auditorium we've heard

1630
00:59:45,109 --> 00:59:43,520
a lot about curiosity's first year on

1631
00:59:46,470 --> 00:59:45,119
mars we've talked a lot about about new

1632
00:59:48,870 --> 00:59:46,480
technologies and some of the research

1633
00:59:50,950 --> 00:59:48,880
and technology you're doing on orbit

1634
00:59:53,349 --> 00:59:50,960
that'll help enable the path for humans

1635
00:59:54,870 --> 00:59:53,359
to mars here soon i want to jump into

1636
00:59:55,910 --> 00:59:54,880
questions here i know there will be many

1637
00:59:57,750 --> 00:59:55,920
for you

1638
01:00:00,230 --> 00:59:57,760

so if you'd stand by for the first and

1639
01:00:03,190 --> 01:00:00,240
we will get started

1640
01:00:03,200 --> 01:00:06,950
okay

1641
01:00:16,390 --> 01:00:08,549
so

1642
01:00:16,400 --> 01:00:25,510
thank you thanks for asking

1643
01:00:29,430 --> 01:00:26,950
so i think part part of the question is

1644
01:00:31,430 --> 01:00:29,440
how how is your sort of daily uh daily

1645
01:00:36,069 --> 01:00:31,440
tasks how are things going there day to

1646
01:00:40,230 --> 01:00:37,990
okay sorry about that i think i stepped

1647
01:00:43,829 --> 01:00:40,240
on the the first part of the question

1648
01:00:46,230 --> 01:00:43,839
the day-to-day life is is really it's

1649
01:00:48,230 --> 01:00:46,240
you know it's a nice pace it's a busy

1650
01:00:50,069 --> 01:00:48,240
day we wake up around uh

1651
01:00:51,750 --> 01:00:50,079
six have a conference with the ground at

1652
01:00:54,710 --> 01:00:51,760
7 30 and then work right straight

1653
01:00:56,309 --> 01:00:54,720
through until another conference at 7 30

1654
01:00:58,549 --> 01:00:56,319
at night but in that time is a break for

1655
01:01:01,750 --> 01:00:58,559
lunch and exercise which is is

1656
01:01:03,829 --> 01:01:01,760
critically important uh for us for many

1657
01:01:05,990 --> 01:01:03,839
reasons but it's a it's a nice steady

1658
01:01:08,150 --> 01:01:06,000
pace of the day and at the end of the

1659
01:01:09,589 --> 01:01:08,160
day it's really fun to eat and join

1660
01:01:11,990 --> 01:01:09,599
meals with the whole crew and look out

1661
01:01:15,030 --> 01:01:12,000
the window tell stories and and and that

1662
01:01:16,390 --> 01:01:15,040
sort of thing it's a nice day

1663
01:01:20,470 --> 01:01:16,400

question here in the front and then

1664
01:01:24,950 --> 01:01:23,430
with the issue they had with the

1665
01:01:27,829 --> 01:01:24,960
humidity or

1666
01:01:29,190 --> 01:01:27,839
water in the spacesuit in the few days

1667
01:01:32,549 --> 01:01:29,200
ago

1668
01:01:34,789 --> 01:01:32,559
is that going to affect any other extra

1669
01:01:40,230 --> 01:01:34,799
vehicular activities or

1670
01:01:43,670 --> 01:01:41,750
you know that's a that's a really good

1671
01:01:45,589 --> 01:01:43,680
question um right now we're we've been

1672
01:01:49,270 --> 01:01:45,599
doing some troubleshooting in the last

1673
01:01:52,470 --> 01:01:49,280
few weeks to really zone in on exactly

1674
01:01:54,150 --> 01:01:52,480
what part of of the suit the internal

1675
01:01:57,270 --> 01:01:54,160
components of the suit which part was it

1676
01:01:59,109 --> 01:01:57,280
that failed and then to

1677
01:02:01,030 --> 01:01:59,119
eliminate that as a problem that could

1678
01:02:03,109 --> 01:02:01,040
be potential across the fleet of

1679
01:02:05,109 --> 01:02:03,119
spacesuits we we want to make sure that

1680
01:02:06,789 --> 01:02:05,119
it's isolated to that one suit before we

1681
01:02:08,710 --> 01:02:06,799
sign up for other people going out the

1682
01:02:11,510 --> 01:02:08,720
door because that's the most important

1683
01:02:13,990 --> 01:02:11,520
thing is making sure that every

1684
01:02:16,870 --> 01:02:14,000
eva team that we send out from now on is

1685
01:02:18,549 --> 01:02:16,880
is uh is for as a result of what we

1686
01:02:20,710 --> 01:02:18,559
learned from from these findings so

1687
01:02:23,270 --> 01:02:20,720
that's happening right now i don't think

1688
01:02:25,270 --> 01:02:23,280

that uh we'll there'll be any there's no

1689
01:02:27,670 --> 01:02:25,280
emergent need for a spacewalk right now

1690
01:02:30,309 --> 01:02:27,680
and until there is we'll make sure we'll

1691
01:02:32,950 --> 01:02:30,319
continue the steady pace of work to to

1692
01:02:34,710 --> 01:02:32,960
find out these things uh and then when

1693
01:02:36,789 --> 01:02:34,720
it's when the time is right and the team

1694
01:02:38,390 --> 01:02:36,799
is happy we'll be we'll be ready for a

1695
01:02:41,430 --> 01:02:38,400
regular routine spacewalks again but

1696
01:02:41,440 --> 01:02:44,950
question in the front

1697
01:02:48,950 --> 01:02:46,549
hey

1698
01:02:50,789 --> 01:02:48,960
where were you guys a year ago on msl's

1699
01:02:58,630 --> 01:02:50,799
landing and how are you celebrating

1700
01:03:01,670 --> 01:03:00,069
gosh we're talking about it trying to

1701
01:03:03,670 --> 01:03:01,680
remember where we were and i i don't

1702
01:03:05,750 --> 01:03:03,680
remember i remember seeing it on the

1703
01:03:08,150 --> 01:03:05,760
news and i remember watching and i

1704
01:03:10,069 --> 01:03:08,160
remember just seeing what a huge impact

1705
01:03:11,349 --> 01:03:10,079
it was i remember seeing a picture of

1706
01:03:13,030 --> 01:03:11,359
times square

1707
01:03:15,990 --> 01:03:13,040
where just

1708
01:03:17,510 --> 01:03:16,000
thousands of people watching in awe um i

1709
01:03:19,829 --> 01:03:17,520
think i might have been in russia at the

1710
01:03:21,910 --> 01:03:19,839
time actually i honestly don't remember

1711
01:03:23,670 --> 01:03:21,920
the past year has been such a haze of

1712
01:03:26,470 --> 01:03:23,680
traveling back and forth for for

1713
01:03:28,470 --> 01:03:26,480

training but i do remember though

1714
01:03:30,710 --> 01:03:28,480
what an impact that it made on the

1715
01:03:33,190 --> 01:03:30,720
entire world and i i was actually quite

1716
01:03:34,710 --> 01:03:33,200
fascinated by that because and it

1717
01:03:36,390 --> 01:03:34,720
impressed me and i think it helped with

1718
01:03:39,670 --> 01:03:36,400
the way social media is working these

1719
01:03:42,549 --> 01:03:39,680
days and um and just what a fantastic

1720
01:03:44,789 --> 01:03:42,559
job that that the group at jpl did with

1721
01:03:47,109 --> 01:03:44,799
this um with this rover and

1722
01:03:51,349 --> 01:03:47,119
and again just fascinated by what an

1723
01:03:54,470 --> 01:03:52,870
okay we'll take a question from social

1724
01:03:57,829 --> 01:03:54,480
media

1725
01:03:59,109 --> 01:03:57,839
sure twitter user micah winston asks

1726
01:04:00,789 --> 01:03:59,119
what would you say is the most

1727
01:04:06,950 --> 01:04:00,799
interesting experiment being done on the

1728
01:04:09,990 --> 01:04:08,470
it's hard to hone in on the most

1729
01:04:12,470 --> 01:04:10,000
interesting because there are there's

1730
01:04:14,069 --> 01:04:12,480
such a breadth of of different topics

1731
01:04:16,069 --> 01:04:14,079
that we're studying

1732
01:04:17,910 --> 01:04:16,079
some of the those that i think we find

1733
01:04:19,750 --> 01:04:17,920
the most interest in are the ones that

1734
01:04:21,750 --> 01:04:19,760
they're doing on the human body and you

1735
01:04:23,430 --> 01:04:21,760
know partly because because we're the

1736
01:04:25,349 --> 01:04:23,440
actual subjects for them and so we're

1737
01:04:28,230 --> 01:04:25,359
intimately involved in the experiments

1738
01:04:30,069 --> 01:04:28,240

but also also in the regard that it's

1739
01:04:31,829 --> 01:04:30,079
something that's very important if we're

1740
01:04:34,470 --> 01:04:31,839
going to be traveling farther away from

1741
01:04:36,230 --> 01:04:34,480
low earth orbit it's um obviously going

1742
01:04:38,950 --> 01:04:36,240
to be a very long trip and what happens

1743
01:04:40,150 --> 01:04:38,960
to our bodies not just how they change

1744
01:04:42,710 --> 01:04:40,160
in

1745
01:04:44,390 --> 01:04:42,720
the lack of gravity but to be sure that

1746
01:04:46,630 --> 01:04:44,400
we're going to be in shape to do work

1747
01:04:48,870 --> 01:04:46,640
when we get wherever we're going if we

1748
01:04:50,549 --> 01:04:48,880
make a trip to mars you know there will

1749
01:04:53,109 --> 01:04:50,559
be some gravity when we get there and if

1750
01:04:56,309 --> 01:04:53,119
we just let our bodies adapt to what

1751
01:04:57,990 --> 01:04:56,319
zero gravity environment is then we will

1752
01:05:00,950 --> 01:04:58,000
be pretty much useless when we get there

1753
01:05:02,309 --> 01:05:00,960
unable to stand unable to walk unable to

1754
01:05:04,630 --> 01:05:02,319
you know our muscles will have degraded

1755
01:05:06,549 --> 01:05:04,640
our bones with will have degraded so so

1756
01:05:08,950 --> 01:05:06,559
i think some of the best

1757
01:05:10,470 --> 01:05:08,960
the most interesting in that regard is

1758
01:05:13,510 --> 01:05:10,480
is the work that we're doing on what's

1759
01:05:15,029 --> 01:05:13,520
happening to the human body

1760
01:05:17,270 --> 01:05:15,039
sure we have another question here from

1761
01:05:26,789 --> 01:05:17,280
twitter from chris connors what is your

1762
01:05:31,750 --> 01:05:29,990
well let's see there's a

1763
01:05:33,910 --> 01:05:31,760

sort of silly answer

1764
01:05:36,870 --> 01:05:33,920
is we have some when when something

1765
01:05:39,349 --> 01:05:36,880
needs to be stored up in the in the jlp

1766
01:05:41,109 --> 01:05:39,359
the japanese logistics area

1767
01:05:44,309 --> 01:05:41,119
and if if we're in node one that's about

1768
01:05:45,829 --> 01:05:44,319
as far as you can go in a translation so

1769
01:05:48,390 --> 01:05:45,839
it's really fun to

1770
01:05:50,309 --> 01:05:48,400
to go flying in a controlled way but

1771
01:05:52,390 --> 01:05:50,319
flying around the corners to make that

1772
01:05:55,430 --> 01:05:52,400
stowage happen that's a sort of a silly

1773
01:05:57,829 --> 01:05:55,440
answer to a fun thing but uh on a more

1774
01:06:00,390 --> 01:05:57,839
work related basis i i find it rewarding

1775
01:06:02,630 --> 01:06:00,400
to fix things and just like in your

1776
01:06:04,710 --> 01:06:02,640
house things break up here or or they

1777
01:06:07,430 --> 01:06:04,720
need maintenance and attention and it's

1778
01:06:09,829 --> 01:06:07,440
really rewarding when the ground team

1779
01:06:12,789 --> 01:06:09,839
puts together a procedure and we

1780
01:06:15,430 --> 01:06:12,799
work that procedure and and as a team we

1781
01:06:16,870 --> 01:06:15,440
repair a broken pump or a broken

1782
01:06:18,390 --> 01:06:16,880
fan or something like that i think

1783
01:06:25,990 --> 01:06:18,400
that's really rewarding and find that

1784
01:06:30,230 --> 01:06:28,069
i saw karen post a picture of a

1785
01:06:31,910 --> 01:06:30,240
constellation a few weeks ago and i'm

1786
01:06:34,309 --> 01:06:31,920
just wondering compared to here on earth

1787
01:06:43,270 --> 01:06:34,319
how does how do the stars and

1788
01:06:46,870 --> 01:06:44,789

all the external

1789
01:06:49,510 --> 01:06:46,880
are off and then all the lights we have

1790
01:06:51,109 --> 01:06:49,520
inside um the node 3 area where our

1791
01:06:53,430 --> 01:06:51,119
cupola is where we look

1792
01:06:56,069 --> 01:06:53,440
and your eyes start to adjust it it's

1793
01:06:58,470 --> 01:06:56,079
amazing and i remember on our on my

1794
01:06:59,990 --> 01:06:58,480
first shuttle flight when we

1795
01:07:05,270 --> 01:07:00,000
we turned off all the lights when we

1796
01:07:08,470 --> 01:07:06,789
without going looking through the

1797
01:07:11,109 --> 01:07:08,480
atmosphere you don't see the same

1798
01:07:14,309 --> 01:07:11,119
twinkle that you do of the stars they're

1799
01:07:16,470 --> 01:07:14,319
very solid and very very bright and you

1800
01:07:18,390 --> 01:07:16,480
could also very easily pick out the

1801
01:07:20,789 --> 01:07:18,400
milky way

1802
01:07:22,950 --> 01:07:20,799
and it just you start to see contrast in

1803
01:07:27,589 --> 01:07:22,960
in the dark sky

1804
01:07:31,829 --> 01:07:29,029
um

1805
01:07:39,430 --> 01:07:31,839
now that you've left earth how do you

1806
01:07:43,510 --> 01:07:40,789
you know

1807
01:07:46,870 --> 01:07:43,520
that's a fun thing to think about er and

1808
01:07:50,870 --> 01:07:46,880
uh i like to think of myself

1809
01:07:52,630 --> 01:07:50,880
as a um a little element on on a mapping

1810
01:07:54,950 --> 01:07:52,640
program google earth or something and

1811
01:07:57,270 --> 01:07:54,960
zoom out from whatever area i'm looking

1812
01:07:59,589 --> 01:07:57,280
at and up to the perspective that i'm

1813
01:08:02,069 --> 01:07:59,599

looking at from the space station and

1814
01:08:03,670 --> 01:08:02,079
that's a fun mental exercise to do

1815
01:08:05,270 --> 01:08:03,680
that's just the visual aspect but i

1816
01:08:07,589 --> 01:08:05,280
think your question is probably deeper

1817
01:08:10,150 --> 01:08:07,599
than that talking about how do i

1818
01:08:13,029 --> 01:08:10,160
personally think about the planet and

1819
01:08:14,309 --> 01:08:13,039
what what strikes me is its beautiful

1820
01:08:17,269 --> 01:08:14,319
simplicity

1821
01:08:20,709 --> 01:08:17,279
and it's our own spaceship for all of us

1822
01:08:23,349 --> 01:08:20,719
and that we as a as a whole mankind need

1823
01:08:25,669 --> 01:08:23,359
to take care of that spaceship and

1824
01:08:27,669 --> 01:08:25,679
that's what being up here has really

1825
01:08:29,590 --> 01:08:27,679
given me the perspective on the

1826
01:08:31,349 --> 01:08:29,600
importance of taking care of our planet

1827
01:08:33,269 --> 01:08:31,359
earth

1828
01:08:34,630 --> 01:08:33,279
i see a young blue suit astronaut in

1829
01:08:36,870 --> 01:08:34,640
training in the audience who has a

1830
01:08:38,789 --> 01:08:36,880
question for you too

1831
01:08:42,229 --> 01:08:38,799
why do you guys live in the

1832
01:08:43,910 --> 01:08:42,239
international space station

1833
01:08:52,550 --> 01:08:43,920
why do you live in the international

1834
01:08:54,950 --> 01:08:54,149
one of the main things that we want to

1835
01:08:56,709 --> 01:08:54,960
do

1836
01:09:00,309 --> 01:08:56,719
here at the international space station

1837
01:09:02,950 --> 01:09:00,319
as you can see we have no gravity

1838
01:09:05,030 --> 01:09:02,960

i'm going to lose myself

1839
01:09:07,110 --> 01:09:05,040
and there are a lot of things we can

1840
01:09:09,030 --> 01:09:07,120
study without gravity when you're on

1841
01:09:11,030 --> 01:09:09,040
earth you drop something and it falls

1842
01:09:13,189 --> 01:09:11,040
and it affects absolutely everything

1843
01:09:16,950 --> 01:09:13,199
when gravity pulls on it and so what we

1844
01:09:19,430 --> 01:09:16,960
can do here is study how liquids

1845
01:09:21,110 --> 01:09:19,440
and various things work and what they

1846
01:09:22,789 --> 01:09:21,120
what they want to do on their own

1847
01:09:25,749 --> 01:09:22,799
without that pull of gravity and that's

1848
01:09:27,829 --> 01:09:25,759
very important for helping solve some of

1849
01:09:30,149 --> 01:09:27,839
the questions that scientists have about

1850
01:09:31,910 --> 01:09:30,159
how things work on the earth and it also

1851
01:09:33,669 --> 01:09:31,920
is very important for us to answer some

1852
01:09:35,749 --> 01:09:33,679
of the questions of how we can travel

1853
01:09:38,229 --> 01:09:35,759
even further than the international

1854
01:09:39,189 --> 01:09:38,239
space station and explore just like it's

1855
01:09:43,590 --> 01:09:39,199
our

1856
01:09:47,669 --> 01:09:45,990
from twitter user leah crane can you see

1857
01:09:56,470 --> 01:09:47,679
meteors burning up in the atmosphere

1858
01:10:00,229 --> 01:09:58,790
actually yes i haven't seen one since

1859
01:10:02,950 --> 01:10:00,239
i've been up here in the past couple

1860
01:10:04,310 --> 01:10:02,960
months but i i do remember on on my

1861
01:10:05,990 --> 01:10:04,320
shuttle flight

1862
01:10:07,830 --> 01:10:06,000
perhaps it was that time that period of

1863
01:10:09,750 --> 01:10:07,840

time when we were all in the flight deck

1864
01:10:12,870 --> 01:10:09,760
looking out the windows that we could

1865
01:10:21,750 --> 01:10:12,880
see shooting stars below us

1866
01:10:27,350 --> 01:10:24,310
go ahead hi what are some challenges to

1867
01:10:33,110 --> 01:10:27,360
everyday life um in zero gravity

1868
01:10:38,390 --> 01:10:35,110
well like uh karen was just talking

1869
01:10:40,149 --> 01:10:38,400
about gravity the absence of it can be a

1870
01:10:41,750 --> 01:10:40,159
challenge it can also be very helpful

1871
01:10:44,550 --> 01:10:41,760
when we're working obviously with large

1872
01:10:47,990 --> 01:10:44,560
mass things it's nice not to have that

1873
01:10:49,510 --> 01:10:48,000
gravity pull but with smaller things

1874
01:10:51,030 --> 01:10:49,520
it's actually pretty inconvenient if

1875
01:10:52,870 --> 01:10:51,040
you're taking apart something with

1876
01:10:55,270 --> 01:10:52,880
screws or small parts

1877
01:10:56,390 --> 01:10:55,280
what do you do with all those items and

1878
01:10:59,110 --> 01:10:56,400
we use

1879
01:11:01,270 --> 01:10:59,120
gray tape for instance and and put stick

1880
01:11:03,110 --> 01:11:01,280
things to that or we'll put

1881
01:11:04,870 --> 01:11:03,120
if it's a larger item we'll put it up

1882
01:11:06,229 --> 01:11:04,880
against the inlet of a fan and it'll

1883
01:11:08,229 --> 01:11:06,239
hold it in place

1884
01:11:11,189 --> 01:11:08,239
those kind of things are our everyday

1885
01:11:12,470 --> 01:11:11,199
challenges that that we face as we as we

1886
01:11:14,310 --> 01:11:12,480
work up here

1887
01:11:16,790 --> 01:11:14,320
and uh and then the challenges to

1888
01:11:18,709 --> 01:11:16,800

ourselves is if we did not do any

1889
01:11:21,110 --> 01:11:18,719
exercise i'm sure you've heard about

1890
01:11:22,630 --> 01:11:21,120
this um our bones would just atrophy and

1891
01:11:24,950 --> 01:11:22,640
they would think ah they don't i don't

1892
01:11:28,310 --> 01:11:24,960
need to work so i can i can quit doing

1893
01:11:30,950 --> 01:11:28,320
my bone thing here and uh and our job is

1894
01:11:32,870 --> 01:11:30,960
to work consistently work those bones so

1895
01:11:34,229 --> 01:11:32,880
that we minimize that bone density loss

1896
01:11:35,910 --> 01:11:34,239
when we get back to the earth so those

1897
01:11:39,510 --> 01:11:35,920
are a few challenges that we have on

1898
01:11:43,270 --> 01:11:40,709
we have another

1899
01:11:45,830 --> 01:11:43,280
question here from twitter user isgamor

1900
01:11:47,669 --> 01:11:45,840
the idea of extending iss beyond 2020

1901
01:11:49,270 --> 01:11:47,679
seems to be a given are there any real

1902
01:11:56,790 --> 01:11:49,280
hurdles that must be cleared besides

1903
01:12:02,149 --> 01:11:59,110
i think one of the big things is

1904
01:12:03,590 --> 01:12:02,159
that things tend to to break down after

1905
01:12:06,149 --> 01:12:03,600
after they've been used for a certain

1906
01:12:07,910 --> 01:12:06,159
amount of time and engineers that built

1907
01:12:10,390 --> 01:12:07,920
and designed and built the space station

1908
01:12:13,270 --> 01:12:10,400
tried really hard to use equipment that

1909
01:12:15,350 --> 01:12:13,280
had long life time but you think about

1910
01:12:17,189 --> 01:12:15,360
in your own home an air conditioning

1911
01:12:18,950 --> 01:12:17,199
unit is only going to last for so many

1912
01:12:21,189 --> 01:12:18,960
years before you either have to replace

1913
01:12:23,910 --> 01:12:21,199

the entire thing or replace one of the

1914
01:12:25,830 --> 01:12:23,920
one of the pieces of it and here on the

1915
01:12:28,630 --> 01:12:25,840
space station you know luckily we do

1916
01:12:30,790 --> 01:12:28,640
have the access of various cargo

1917
01:12:32,790 --> 01:12:30,800
vehicles that can bring up spare parts

1918
01:12:34,550 --> 01:12:32,800
but as the station ages i you know i

1919
01:12:36,470 --> 01:12:34,560
think more and more things might start

1920
01:12:37,910 --> 01:12:36,480
breaking and and it's hard to anticipate

1921
01:12:39,510 --> 01:12:37,920
exactly what's going to break like with

1922
01:12:41,669 --> 01:12:39,520
the spacesuit problem we had a couple

1923
01:12:43,430 --> 01:12:41,679
weeks ago nobody probably ever would

1924
01:12:45,750 --> 01:12:43,440
have thought that we would have had that

1925
01:12:47,669 --> 01:12:45,760
malfunction but we did and i think that

1926
01:12:49,590 --> 01:12:47,679
that's bound to happen and so i think

1927
01:12:50,790 --> 01:12:49,600
that will be a struggle as we continue

1928
01:12:53,990 --> 01:12:50,800
on but not something that's

1929
01:12:58,550 --> 01:12:56,310
yeah besides the fun of flying from one

1930
01:13:00,310 --> 01:12:58,560
end of the space station to the other

1931
01:13:01,590 --> 01:13:00,320
given a little bit of free time that you

1932
01:13:03,350 --> 01:13:01,600
do get

1933
01:13:05,669 --> 01:13:03,360
how much time do you spend just looking

1934
01:13:07,750 --> 01:13:05,679
out the window in the cupola and then

1935
01:13:09,990 --> 01:13:07,760
also could you describe the first time

1936
01:13:11,510 --> 01:13:10,000
on station when you went in there what

1937
01:13:16,470 --> 01:13:11,520
that feeling was like looking out those

1938
01:13:20,950 --> 01:13:18,149

yeah you hit the nail on the head the

1939
01:13:22,790 --> 01:13:20,960
cupola is just a magnificent place to go

1940
01:13:24,870 --> 01:13:22,800
and when both karen and i were here on

1941
01:13:27,110 --> 01:13:24,880
our shuttle flights that cupola was not

1942
01:13:28,390 --> 01:13:27,120
part of the space station so for me the

1943
01:13:30,310 --> 01:13:28,400
first time

1944
01:13:32,390 --> 01:13:30,320
seeing it for real with my own eyes was

1945
01:13:35,030 --> 01:13:32,400
when i arrived here

1946
01:13:38,310 --> 01:13:35,040
several months ago and just like you

1947
01:13:40,550 --> 01:13:38,320
alluded to it's breathtaking i mean you

1948
01:13:42,630 --> 01:13:40,560
i remember actually the first time is

1949
01:13:44,229 --> 01:13:42,640
when i opened the window shutters myself

1950
01:13:46,709 --> 01:13:44,239
so each of the windows has a shutter

1951
01:13:49,590 --> 01:13:46,719
that you can open it with a manual turn

1952
01:13:51,350 --> 01:13:49,600
and as i did i remember just looking out

1953
01:13:52,950 --> 01:13:51,360
there and seeing the earth

1954
01:13:54,470 --> 01:13:52,960
out of one window then another window

1955
01:13:57,110 --> 01:13:54,480
and another window and it seemed like i

1956
01:14:00,709 --> 01:13:57,120
was in my own real life imax movie or

1957
01:14:02,550 --> 01:14:00,719
something 360 degrees of the earth and

1958
01:14:04,390 --> 01:14:02,560
and the other thing that's interesting

1959
01:14:06,310 --> 01:14:04,400
that you don't really think about

1960
01:14:07,910 --> 01:14:06,320
is it's on the bottom of the space

1961
01:14:10,149 --> 01:14:07,920
station and you go in there and your

1962
01:14:12,229 --> 01:14:10,159
head is directly to the earth so you're

1963
01:14:14,870 --> 01:14:12,239

upside down and it's a little

1964
01:14:16,550 --> 01:14:14,880
disorienting at first as if you're in an

1965
01:14:18,950 --> 01:14:16,560
airplane and you go inverted and you're

1966
01:14:20,470 --> 01:14:18,960
flying over you're an area that you

1967
01:14:22,790 --> 01:14:20,480
you're familiar with like your hometown

1968
01:14:24,950 --> 01:14:22,800
or something you look left and you look

1969
01:14:26,550 --> 01:14:24,960
right you have to reorient your brain

1970
01:14:28,790 --> 01:14:26,560
and and that took me some time getting

1971
01:14:31,350 --> 01:14:28,800
used to okay left means right right

1972
01:14:33,430 --> 01:14:31,360
means left and that sort of thing

1973
01:14:34,790 --> 01:14:33,440
so it's just a really really neat place

1974
01:14:36,149 --> 01:14:34,800
to go and i think the first part of your

1975
01:14:38,229 --> 01:14:36,159
question is how much time do we spend

1976
01:14:40,870 --> 01:14:38,239
there well as much time as we can

1977
01:14:42,630 --> 01:14:40,880
after the our evening dpc daily planning

1978
01:14:44,470 --> 01:14:42,640
conference we'll have dinner and then

1979
01:14:46,149 --> 01:14:44,480
usually

1980
01:14:48,070 --> 01:14:46,159
people trickle up to the

1981
01:14:49,750 --> 01:14:48,080
cupola to take pictures and see where we

1982
01:14:53,430 --> 01:14:49,760
are on the planet and just look before

1983
01:14:58,149 --> 01:14:56,470
twitter user chief r.a asks do you feel

1984
01:15:04,709 --> 01:14:58,159
ready to go to mars if you could leave

1985
01:15:07,430 --> 01:15:06,470
that's an interesting question to try to

1986
01:15:08,870 --> 01:15:07,440
answer

1987
01:15:10,390 --> 01:15:08,880
i think

1988
01:15:13,270 --> 01:15:10,400

you know i could look at it personally

1989
01:15:15,590 --> 01:15:13,280
me ready or or us ready

1990
01:15:17,830 --> 01:15:15,600
again we could go back looking at us and

1991
01:15:20,229 --> 01:15:17,840
whether whether you know people are

1992
01:15:22,550 --> 01:15:20,239
ready to go in general the problems like

1993
01:15:24,390 --> 01:15:22,560
i just talked about fixing things

1994
01:15:25,669 --> 01:15:24,400
we have to remember that when we start a

1995
01:15:27,189 --> 01:15:25,679
trip to mars we're not going to have

1996
01:15:28,950 --> 01:15:27,199
those cargo vehicles to come and

1997
01:15:31,270 --> 01:15:28,960
resupply us we're not going to have the

1998
01:15:32,870 --> 01:15:31,280
cargo vehicles to to send up at the last

1999
01:15:35,750 --> 01:15:32,880
moment a spare part that we didn't

2000
01:15:37,110 --> 01:15:35,760
realize we were going to need and so

2001
01:15:38,790 --> 01:15:37,120
you know the work we're doing here on

2002
01:15:41,030 --> 01:15:38,800
the space station just running the space

2003
01:15:43,750 --> 01:15:41,040
station on a day-to-day basis i think is

2004
01:15:45,830 --> 01:15:43,760
a good test bed for for what we're going

2005
01:15:47,510 --> 01:15:45,840
to need to go to mars but i think i

2006
01:15:49,990 --> 01:15:47,520
think there's still some work to be done

2007
01:15:51,590 --> 01:15:50,000
i i'm confident we'll get there but

2008
01:15:53,510 --> 01:15:51,600
i think there's just a lot of things to

2009
01:15:55,750 --> 01:15:53,520
think about knowing that it's it's a

2010
01:15:56,870 --> 01:15:55,760
trip that that can't be resupplied can't

2011
01:15:58,790 --> 01:15:56,880
be um

2012
01:16:01,030 --> 01:15:58,800
you know once you're going you're going

2013
01:16:02,630 --> 01:16:01,040

and uh you know i think we'll get there

2014
01:16:04,390 --> 01:16:02,640
eventually but i think right now there's

2015
01:16:07,030 --> 01:16:04,400
there's still a lot of work to do

2016
01:16:10,390 --> 01:16:07,040
okay one more question from the audience

2017
01:16:12,390 --> 01:16:10,400
banking off of the uh the cupola um we

2018
01:16:15,189 --> 01:16:12,400
know that luca seems to have an affinity

2019
01:16:17,430 --> 01:16:15,199
of imaging italy um since we didn't we

2020
01:16:19,430 --> 01:16:17,440
know that chris is uh tweetless what are

2021
01:16:24,390 --> 01:16:19,440
your favorite spots of earth to take

2022
01:16:27,910 --> 01:16:26,390
well thank you for giving me opportunity

2023
01:16:31,030 --> 01:16:27,920
to answer this question with more than

2024
01:16:33,590 --> 01:16:31,040
140 characters

2025
01:16:34,630 --> 01:16:33,600
my favorite place to look

2026
01:16:38,790 --> 01:16:34,640
is

2027
01:16:40,550 --> 01:16:38,800
really mean it it's where

2028
01:16:43,510 --> 01:16:40,560
the uh

2029
01:16:45,430 --> 01:16:43,520
the oceans meet river areas you know the

2030
01:16:47,750 --> 01:16:45,440
river deltas and things you just get

2031
01:16:49,990 --> 01:16:47,760
really really interesting and neat

2032
01:16:52,870 --> 01:16:50,000
patterns in the ocean and the brown

2033
01:16:55,110 --> 01:16:52,880
where the brown river meets the blues of

2034
01:16:56,950 --> 01:16:55,120
the ocean and you can see that the tidal

2035
01:16:58,870 --> 01:16:56,960
patterns and things like this i just

2036
01:17:01,430 --> 01:16:58,880
find that really really cool so that's

2037
01:17:03,910 --> 01:17:01,440
the area that i i like to to look around

2038
01:17:06,310 --> 01:17:03,920

and usually there's a lot of cities are

2039
01:17:08,950 --> 01:17:06,320
obviously around the the um the oceans

2040
01:17:11,830 --> 01:17:08,960
as well so at night it's it's an an

2041
01:17:14,550 --> 01:17:11,840
easier place to find major cities and

2042
01:17:18,229 --> 01:17:14,560
you can kind of direct your vision uh

2043
01:17:20,709 --> 01:17:18,239
okay that's um that's washington dc new

2044
01:17:23,030 --> 01:17:20,719
york there's boston kind of a thing and

2045
01:17:25,110 --> 01:17:23,040
as you go up the coastline so the i have

2046
01:17:27,669 --> 01:17:25,120
an affinity for the coastline maybe it's

2047
01:17:29,110 --> 01:17:27,679
my navy background i don't know

2048
01:17:31,430 --> 01:17:29,120
karen chris i know we lose you in just a

2049
01:17:32,790 --> 01:17:31,440
couple of minutes so to here to close us

2050
01:17:34,310 --> 01:17:32,800
out as our is our final speaker for the

2051
01:17:40,070 --> 01:17:34,320
day to say a few words to you it's nasa

2052
01:17:43,189 --> 01:17:41,669
hi karen and chris i know you all have

2053
01:17:45,590 --> 01:17:43,199
to get back to work but let me thank you

2054
01:17:46,470 --> 01:17:45,600
very much for sharing your time with us

2055
01:17:48,870 --> 01:17:46,480
today

2056
01:17:50,550 --> 01:17:48,880
it's fascinating watching you and i i

2057
01:17:52,709 --> 01:17:50,560
listened to the questions

2058
01:17:55,189 --> 01:17:52,719
uh thinking of how i might have answered

2059
01:17:56,630 --> 01:17:55,199
them and i realized how old i am and how

2060
01:17:58,870 --> 01:17:56,640
long it's been since

2061
01:18:00,310 --> 01:17:58,880
i was where you are and uh but i want to

2062
01:18:02,229 --> 01:18:00,320
thank you for everything i want to thank

2063
01:18:03,590 --> 01:18:02,239

you for the just the tremendous job of

2064
01:18:05,430 --> 01:18:03,600
outreach that you have been doing

2065
01:18:08,070 --> 01:18:05,440
throughout your time there

2066
01:18:09,990 --> 01:18:08,080
uh and and congratulations we're

2067
01:18:13,110 --> 01:18:10,000
celebrating a great anniversary here

2068
01:18:15,510 --> 01:18:13,120
today uh anniversary of curiosity's

2069
01:18:17,590 --> 01:18:15,520
landing and i know where i was because i

2070
01:18:22,709 --> 01:18:17,600
was sweating beads at jpl so thanks to

2071
01:18:28,550 --> 01:18:24,229
thank you sir it was an honor to be with

2072
01:18:33,110 --> 01:18:30,950
congratulations to the entire mars

2073
01:18:35,350 --> 01:18:33,120
curiosity team

2074
01:18:37,590 --> 01:18:35,360
thanks so much and let me uh again

2075
01:18:39,270 --> 01:18:37,600
welcome all of you here today and and

2076
01:18:41,590 --> 01:18:39,280
actually to thank you for coming out and

2077
01:18:43,990 --> 01:18:41,600
helping us celebrate the the one year

2078
01:18:45,189 --> 01:18:44,000
anniversary of curiosity's landing on

2079
01:18:47,430 --> 01:18:45,199
mars

2080
01:18:50,790 --> 01:18:47,440
as i as i just mentioned to chris and

2081
01:18:53,189 --> 01:18:50,800
karen um i i was privileged to be in the

2082
01:18:54,950 --> 01:18:53,199
control center at jpl and and we were

2083
01:18:57,350 --> 01:18:54,960
literally sweating beads and biting our

2084
01:18:59,430 --> 01:18:57,360
fingernails uh as some of you may

2085
01:19:01,110 --> 01:18:59,440
remember from wherever you looked i

2086
01:19:02,470 --> 01:19:01,120
think it's incredibly fitting that we

2087
01:19:05,510 --> 01:19:02,480
ended today's

2088
01:19:07,430 --> 01:19:05,520

uh formal presentations uh with a

2089
01:19:08,950 --> 01:19:07,440
conversation with our astronauts on

2090
01:19:11,270 --> 01:19:08,960
board the international space station

2091
01:19:14,149 --> 01:19:11,280
because station is our toe hold on the

2092
01:19:17,430 --> 01:19:14,159
universe it is in fact uh our our

2093
01:19:19,590 --> 01:19:17,440
waypoint to mars and it is in fact the

2094
01:19:21,750 --> 01:19:19,600
probably the last outpost of humanity

2095
01:19:24,470 --> 01:19:21,760
before we find ourselves

2096
01:19:26,950 --> 01:19:24,480
permanently on mars one of these days

2097
01:19:28,149 --> 01:19:26,960
you've heard a lot of about the amazing

2098
01:19:30,229 --> 01:19:28,159
launch

2099
01:19:31,990 --> 01:19:30,239
the seven minutes of terror the entry

2100
01:19:34,149 --> 01:19:32,000
and landing on mars

2101
01:19:36,229 --> 01:19:34,159
and almost daily breakthrough

2102
01:19:39,430 --> 01:19:36,239
discoveries that this that curiosity

2103
01:19:40,310 --> 01:19:39,440
continues to make uh over these past 12

2104
01:19:42,390 --> 01:19:40,320
months

2105
01:19:44,390 --> 01:19:42,400
we've talked about uh other robotic

2106
01:19:46,950 --> 01:19:44,400
missions to the red planet that nasa is

2107
01:19:49,350 --> 01:19:46,960
now planning and i just want to spend a

2108
01:19:51,270 --> 01:19:49,360
few moments talking about why mars is

2109
01:19:53,990 --> 01:19:51,280
the linchpin of nasa's planetary

2110
01:19:56,470 --> 01:19:54,000
exploration strategy and how curiosity

2111
01:19:58,790 --> 01:19:56,480
and other robotic missions are setting

2112
01:20:01,430 --> 01:19:58,800
the stage for the main event a human

2113
01:20:03,990 --> 01:20:01,440

mission to mars in the 2030s

2114
01:20:06,310 --> 01:20:04,000
first of all why mars um you know

2115
01:20:09,030 --> 01:20:06,320
hopefully everybody in this room has an

2116
01:20:11,270 --> 01:20:09,040
answer to that uh or some of you may be

2117
01:20:12,470 --> 01:20:11,280
sitting here and you came out because

2118
01:20:15,430 --> 01:20:12,480
you don't know

2119
01:20:17,189 --> 01:20:15,440
and and you're skeptical and you say i

2120
01:20:18,950 --> 01:20:17,199
think it's stupid you know why do we

2121
01:20:21,350 --> 01:20:18,960
want to do that cost much uh it's

2122
01:20:23,669 --> 01:20:21,360
dangerous uh it takes a lot of time so

2123
01:20:24,950 --> 01:20:23,679
why mars first

2124
01:20:26,470 --> 01:20:24,960
let me say

2125
01:20:28,470 --> 01:20:26,480
that you know mars is the most

2126
01:20:30,550 --> 01:20:28,480
earth-like of any of the planets in our

2127
01:20:33,669 --> 01:20:30,560
solar system

2128
01:20:36,550 --> 01:20:33,679
and so it's why we choose to explore it

2129
01:20:39,350 --> 01:20:36,560
uh if life exists beyond earth and i am

2130
01:20:42,149 --> 01:20:39,360
one who believes that it may very well

2131
01:20:44,390 --> 01:20:42,159
uh mars for me is the most likely place

2132
01:20:47,189 --> 01:20:44,400
that that life will be found

2133
01:20:49,590 --> 01:20:47,199
what we can learn from mars about uh

2134
01:20:52,229 --> 01:20:49,600
about our own earth and what we can

2135
01:20:53,830 --> 01:20:52,239
learn about mars from further studies

2136
01:20:55,750 --> 01:20:53,840
will improve our understanding of

2137
01:20:57,270 --> 01:20:55,760
planetary and biological processes that

2138
01:21:00,550 --> 01:20:57,280

affect the earth

2139
01:21:02,149 --> 01:21:00,560
and our life here from the core

2140
01:21:03,350 --> 01:21:02,159
of our earth to the top of our

2141
01:21:05,750 --> 01:21:03,360
atmosphere

2142
01:21:08,470 --> 01:21:05,760
our conversation with astronauts today

2143
01:21:11,189 --> 01:21:08,480
reminds us that iss is our springboard

2144
01:21:13,430 --> 01:21:11,199
to nasa's next big leap in exploration

2145
01:21:16,070 --> 01:21:13,440
our activities and experiences on the

2146
01:21:18,630 --> 01:21:16,080
iss are significantly contributing to

2147
01:21:21,030 --> 01:21:18,640
sending humans to mars in fact

2148
01:21:22,790 --> 01:21:21,040
when we sit around in quiet meetings if

2149
01:21:24,470 --> 01:21:22,800
there are any such thing here at nasa

2150
01:21:26,870 --> 01:21:24,480
headquarters

2151
01:21:28,550 --> 01:21:26,880
but when we sit around in our meetings

2152
01:21:30,390 --> 01:21:28,560
our safety guys

2153
01:21:32,630 --> 01:21:30,400
always remind us

2154
01:21:35,350 --> 01:21:32,640
as we deliberate on what next you know

2155
01:21:37,669 --> 01:21:35,360
they they ask us over and over um

2156
01:21:38,790 --> 01:21:37,679
are we serious about going to mars

2157
01:21:40,149 --> 01:21:38,800
we say yep

2158
01:21:41,990 --> 01:21:40,159
they say okay

2159
01:21:43,990 --> 01:21:42,000
it's what we're about to do going to

2160
01:21:45,750 --> 01:21:44,000
contribute to going to mars we say yep

2161
01:21:47,110 --> 01:21:45,760
they said all right we're okay with it

2162
01:21:49,350 --> 01:21:47,120
because we shouldn't be putting people

2163
01:21:50,229 --> 01:21:49,360

at risk if we're not really trying to go

2164
01:21:51,750 --> 01:21:50,239
there

2165
01:21:53,270 --> 01:21:51,760
uh because we're doing some we're

2166
01:21:55,189 --> 01:21:53,280
hanging it out every once in a while and

2167
01:21:56,470 --> 01:21:55,199
we're doing some pretty risky stuff and

2168
01:21:57,990 --> 01:21:56,480
we're going to do things that are even

2169
01:21:58,950 --> 01:21:58,000
more risky than anything you've ever

2170
01:22:01,030 --> 01:21:58,960
seen

2171
01:22:02,550 --> 01:22:01,040
nasa attempt before in the coming years

2172
01:22:04,550 --> 01:22:02,560
so

2173
01:22:06,390 --> 01:22:04,560
you know we we need to make sure that

2174
01:22:09,430 --> 01:22:06,400
everything we do is significantly

2175
01:22:11,990 --> 01:22:09,440
contributing to sending humans to mars

2176
01:22:13,910 --> 01:22:12,000
nasa and our international partners are

2177
01:22:16,229 --> 01:22:13,920
confronting challenges on a daily basis

2178
01:22:17,189 --> 01:22:16,239
that are critical to sending humans to

2179
01:22:19,110 --> 01:22:17,199
mars

2180
01:22:20,629 --> 01:22:19,120
this includes life support systems and

2181
01:22:22,629 --> 01:22:20,639
the challenges in maintaining them you

2182
01:22:24,470 --> 01:22:22,639
heard chris and and karen in their

2183
01:22:25,510 --> 01:22:24,480
conversation you know what did karen say

2184
01:22:28,229 --> 01:22:25,520
who would have ever thought we'd have

2185
01:22:31,189 --> 01:22:28,239
had a water leak the magnitude that we

2186
01:22:33,510 --> 01:22:31,199
had uh on the emu on the spacesuit until

2187
01:22:36,229 --> 01:22:33,520
it actually happened uh you know if that

2188
01:22:38,310 --> 01:22:36,239

had been on the way to mars

2189
01:22:39,910 --> 01:22:38,320
there's no getting a replacement unit

2190
01:22:41,990 --> 01:22:39,920
from the ground there's no getting any

2191
01:22:44,950 --> 01:22:42,000
tools from the ground the way that we're

2192
01:22:46,709 --> 01:22:44,960
doing to help us troubleshoot the emu

2193
01:22:49,110 --> 01:22:46,719
right now so we've got a we've got to

2194
01:22:51,110 --> 01:22:49,120
make sure that the systems are solid uh

2195
01:22:52,709 --> 01:22:51,120
when we when we send a crew on the way

2196
01:22:54,790 --> 01:22:52,719
to mars

2197
01:22:56,629 --> 01:22:54,800
there are things about the human body in

2198
01:22:58,629 --> 01:22:56,639
the microgravity environment that we

2199
01:23:00,310 --> 01:22:58,639
still don't understand

2200
01:23:03,030 --> 01:23:00,320
and so human health and performance

2201
01:23:05,510 --> 01:23:03,040
becomes most important to us and chris

2202
01:23:07,510 --> 01:23:05,520
alluded to it again we have to remember

2203
01:23:09,030 --> 01:23:07,520
where when we go to mars

2204
01:23:10,550 --> 01:23:09,040
it is not

2205
01:23:13,510 --> 01:23:10,560
like going to the international space

2206
01:23:16,470 --> 01:23:13,520
station when we go to station we go

2207
01:23:18,790 --> 01:23:16,480
prepared to live six months in a micro

2208
01:23:20,070 --> 01:23:18,800
gravity environment when we go to mars

2209
01:23:21,350 --> 01:23:20,080
we're going to have to prepare to live

2210
01:23:22,550 --> 01:23:21,360
eight months in a micro gravity

2211
01:23:24,870 --> 01:23:22,560
environment

2212
01:23:26,470 --> 01:23:24,880
only to transfer to a gravity

2213
01:23:29,669 --> 01:23:26,480

environment where we're going to be for

2214
01:23:32,310 --> 01:23:29,679
at least a year and maybe even more time

2215
01:23:34,229 --> 01:23:32,320
the body has not done that before where

2216
01:23:36,550 --> 01:23:34,239
it goes uh

2217
01:23:38,310 --> 01:23:36,560
microgravity to a gravity environment

2218
01:23:40,790 --> 01:23:38,320
for a temporary stay back into

2219
01:23:43,110 --> 01:23:40,800
microgravity and then back to earth

2220
01:23:45,590 --> 01:23:43,120
so so challenges abound

2221
01:23:47,910 --> 01:23:45,600
we're using iss as a test bed for

2222
01:23:49,510 --> 01:23:47,920
technologies and systems and you heard

2223
01:23:51,430 --> 01:23:49,520
some of the presenters this morning talk

2224
01:23:53,750 --> 01:23:51,440
about those technologies and systems

2225
01:23:55,669 --> 01:23:53,760
that are under development uh for mars

2226
01:23:57,990 --> 01:23:55,679
exploration with humans

2227
01:24:00,629 --> 01:23:58,000
as you've heard our goal in goals

2228
01:24:02,229 --> 01:24:00,639
include both new uh path-breaking

2229
01:24:04,550 --> 01:24:02,239
robotic missions to mars and a

2230
01:24:06,550 --> 01:24:04,560
groundbreaking asteroid mission on the

2231
01:24:07,590 --> 01:24:06,560
way to our ultimate goal of humans on

2232
01:24:10,229 --> 01:24:07,600
mars

2233
01:24:12,390 --> 01:24:10,239
so the wheels of curiosity are literally

2234
01:24:13,669 --> 01:24:12,400
blazing the trail for human footprints

2235
01:24:15,830 --> 01:24:13,679
on mars

2236
01:24:18,390 --> 01:24:15,840
our success in landing a heavier payload

2237
01:24:20,470 --> 01:24:18,400
on mars with increased precision brings

2238
01:24:23,910 --> 01:24:20,480

us closer to developing capabilities

2239
01:24:25,990 --> 01:24:23,920
necessary for human missions to mars

2240
01:24:27,830 --> 01:24:26,000
measurements taken by msl as it

2241
01:24:30,229 --> 01:24:27,840
delivered the curiosity rover to mars

2242
01:24:32,709 --> 01:24:30,239
last year have provided nasa the

2243
01:24:34,790 --> 01:24:32,719
information to help design systems to

2244
01:24:38,149 --> 01:24:34,800
protect human explorers from radiation

2245
01:24:40,310 --> 01:24:38,159
exposure in future deep space missions

2246
01:24:42,390 --> 01:24:40,320
and as you have also heard our recently

2247
01:24:45,270 --> 01:24:42,400
announced mission to identify

2248
01:24:46,870 --> 01:24:45,280
capture redirect and sample an asteroid

2249
01:24:49,030 --> 01:24:46,880
would mark an unprecedented

2250
01:24:50,870 --> 01:24:49,040
technological achievement to help reach

2251
01:24:54,229 --> 01:24:50,880
the president's goal of sending human to

2252
01:24:56,550 --> 01:24:54,239
humans to mars in the 2030s

2253
01:25:00,149 --> 01:24:56,560
it's important to remember that the u.s

2254
01:25:03,110 --> 01:25:00,159
through nasa was the first and still the

2255
01:25:06,149 --> 01:25:03,120
only nation to land humans on the moon

2256
01:25:08,390 --> 01:25:06,159
in 1969 and after that

2257
01:25:09,189 --> 01:25:08,400
we're determined that america leads the

2258
01:25:13,030 --> 01:25:09,199
way

2259
01:25:15,270 --> 01:25:13,040
to first footprints on mars we know

2260
01:25:17,110 --> 01:25:15,280
we could not do the amazing things we do

2261
01:25:20,550 --> 01:25:17,120
without the support of the president the

2262
01:25:21,990 --> 01:25:20,560
congress and most importantly you the

2263
01:25:23,590 --> 01:25:22,000

american people

2264
01:25:25,510 --> 01:25:23,600
so

2265
01:25:26,470 --> 01:25:25,520
as we wish curiosity a happy first

2266
01:25:29,030 --> 01:25:26,480
birthday

2267
01:25:31,030 --> 01:25:29,040
we offer you our thanks

2268
01:25:33,590 --> 01:25:31,040
with your continued interest and support

2269
01:25:35,430 --> 01:25:33,600
i have no doubt that america will remain

2270
01:25:37,350 --> 01:25:35,440
the world's leading space faring nation

2271
01:25:39,590 --> 01:25:37,360
as we move towards sending

2272
01:25:41,270 --> 01:25:39,600
humans farther into space than we've

2273
01:25:43,830 --> 01:25:41,280
ever gone before

2274
01:25:45,750 --> 01:25:43,840
including an asteroid in mars

2275
01:25:48,790 --> 01:25:45,760
once only dreams

2276
01:25:51,430 --> 01:25:48,800
these goals are now within our grasp

2277
01:25:53,430 --> 01:25:51,440
and we hope you're as excited as we are

2278
01:25:55,430 --> 01:25:53,440
about accepting this challenge

2279
01:25:58,149 --> 01:25:55,440
uh thank you again for coming today and

2280
01:26:00,310 --> 01:25:58,159
i i think there's a little time for a

2281
01:26:01,990 --> 01:26:00,320
few questions if you have them

2282
01:26:09,110 --> 01:26:02,000
they won't let me get here for the

2283
01:26:11,910 --> 01:26:10,790
charlie let me let me start off uh

2284
01:26:14,229 --> 01:26:11,920
there's one thing i like to remind

2285
01:26:15,990 --> 01:26:14,239
people we didn't get to tell a lot of

2286
01:26:17,510 --> 01:26:16,000
the orion sls story because we were

2287
01:26:18,790 --> 01:26:17,520
focused on some overcoming some of the

2288
01:26:20,390 --> 01:26:18,800

challenges and ways we're doing that can

2289
01:26:21,430 --> 01:26:20,400
you say there's a couple of words about

2290
01:26:22,870 --> 01:26:21,440
some of the hardware we're building the

2291
01:26:23,990 --> 01:26:22,880
new rocket and spacecraft will help

2292
01:26:26,070 --> 01:26:24,000
enable this

2293
01:26:27,590 --> 01:26:26,080
path to mars i think somebody's talked

2294
01:26:29,189 --> 01:26:27,600
already or at least hopefully someone's

2295
01:26:30,709 --> 01:26:29,199
talked today a little bit about our

2296
01:26:32,950 --> 01:26:30,719
commercial ventures

2297
01:26:34,629 --> 01:26:32,960
we already have two commercial providers

2298
01:26:36,229 --> 01:26:34,639
that are taking cargo

2299
01:26:38,790 --> 01:26:36,239
or at least two that will be taking

2300
01:26:40,870 --> 01:26:38,800
cargo spacex has had two successful

2301
01:26:43,830 --> 01:26:40,880
launches with their dragon module taking

2302
01:26:47,830 --> 01:26:43,840
uh taking cargo to station and

2303
01:26:50,149 --> 01:26:47,840
antares will be launching the the

2304
01:26:52,149 --> 01:26:50,159
cygnus module for orbital sciences

2305
01:26:54,390 --> 01:26:52,159
hopefully next month so that'll give us

2306
01:26:55,990 --> 01:26:54,400
a second american company taking cargo

2307
01:26:58,870 --> 01:26:56,000
then we have boeing

2308
01:27:00,629 --> 01:26:58,880
spacex and sierra nevada that are vying

2309
01:27:02,070 --> 01:27:00,639
for the opportunity to begin to take our

2310
01:27:04,229 --> 01:27:02,080
astronauts from earth to the

2311
01:27:06,390 --> 01:27:04,239
international space station and love

2312
01:27:08,229 --> 01:27:06,400
other low earth orbit destinations what

2313
01:27:10,070 --> 01:27:08,239

that's allowed us to do is to get out of

2314
01:27:12,149 --> 01:27:10,080
the low earth orbit business to get out

2315
01:27:14,709 --> 01:27:12,159
of the access to space business and

2316
01:27:17,350 --> 01:27:14,719
really focus on putting together

2317
01:27:19,430 --> 01:27:17,360
the systems that will allow us to take

2318
01:27:21,110 --> 01:27:19,440
humans take our astronauts to asteroids

2319
01:27:23,189 --> 01:27:21,120
and onto mars and perhaps even other

2320
01:27:24,629 --> 01:27:23,199
places and those two vehicles that we

2321
01:27:27,270 --> 01:27:24,639
have chosen

2322
01:27:28,870 --> 01:27:27,280
are called the sls right now lacking a

2323
01:27:31,430 --> 01:27:28,880
name and everybody's pressing me to get

2324
01:27:33,590 --> 01:27:31,440
a name but i like sls the space launch

2325
01:27:36,790 --> 01:27:33,600
system or heavy lift launch vehicle

2326
01:27:38,550 --> 01:27:36,800
and uh in orion the crew module its

2327
01:27:39,830 --> 01:27:38,560
formal name is multi-purpose crew

2328
01:27:42,229 --> 01:27:39,840
vehicle

2329
01:27:43,270 --> 01:27:42,239
they are well on their way to being

2330
01:27:44,790 --> 01:27:43,280
developed

2331
01:27:46,790 --> 01:27:44,800
we just finished what we call a

2332
01:27:49,669 --> 01:27:46,800
preliminary design review which was a

2333
01:27:51,430 --> 01:27:49,679
very critical milestone for sls up at

2334
01:27:52,870 --> 01:27:51,440
the marshall space flight center just

2335
01:27:55,750 --> 01:27:52,880
last month

2336
01:27:58,950 --> 01:27:55,760
we'll have a similar milestone come for

2337
01:28:02,310 --> 01:27:58,960
orion this fall and that'll tell us that

2338
01:28:04,709 --> 01:28:02,320

that we're on a a steady path to having

2339
01:28:07,510 --> 01:28:04,719
both of these vehicles ready to fly

2340
01:28:09,910 --> 01:28:07,520
orion the crew vehicle in a shell of a

2341
01:28:12,830 --> 01:28:09,920
form will fly its first time

2342
01:28:15,270 --> 01:28:12,840
uh the fall of next year fall of

2343
01:28:18,149 --> 01:28:15,280
2014 we'll launch it on a delta iv

2344
01:28:21,030 --> 01:28:18,159
rocket from cape canaveral florida and

2345
01:28:22,950 --> 01:28:21,040
send it into an orbit that uh will get

2346
01:28:24,390 --> 01:28:22,960
it high enough and fast enough such that

2347
01:28:26,310 --> 01:28:24,400
when it comes back to re-enter earth's

2348
01:28:28,950 --> 01:28:26,320
atmosphere it's going at about the

2349
01:28:30,709 --> 01:28:28,960
speeds that we would fly for a mission

2350
01:28:31,910 --> 01:28:30,719
back from the moon or from mars so we

2351
01:28:34,070 --> 01:28:31,920
want to demonstrate that it can

2352
01:28:36,870 --> 01:28:34,080
withstand the pressures and temperatures

2353
01:28:39,830 --> 01:28:36,880
of re-entry at those speeds sls is

2354
01:28:41,669 --> 01:28:39,840
scheduled for its first flight in 2017.

2355
01:28:43,030 --> 01:28:41,679
we'll put it together again with an

2356
01:28:44,709 --> 01:28:43,040
uncrewed

2357
01:28:46,470 --> 01:28:44,719
orion module and that will be the first

2358
01:28:49,189 --> 01:28:46,480
time that you actually see us launch and

2359
01:28:52,790 --> 01:28:49,199
fly them as an integrated system and

2360
01:28:55,350 --> 01:28:52,800
that's leading us to a 20 hopefully 2020

2361
01:28:58,229 --> 01:28:55,360
mission of sls on orion with a crude

2362
01:29:00,950 --> 01:28:58,239
vehicle this time and if all goes well

2363
01:29:02,229 --> 01:29:00,960

and the asteroid initiative that's that

2364
01:29:04,470 --> 01:29:02,239
i think we may have talked to you a

2365
01:29:06,149 --> 01:29:04,480
little bit about earlier today if all

2366
01:29:08,629 --> 01:29:06,159
that works out and we have an asteroid

2367
01:29:10,950 --> 01:29:08,639
that's in place in orbit uh around the

2368
01:29:13,350 --> 01:29:10,960
moon then that that mission may actually

2369
01:29:14,790 --> 01:29:13,360
be one of the first times that humans

2370
01:29:17,750 --> 01:29:14,800
have an opportunity to encounter an

2371
01:29:19,510 --> 01:29:17,760
asteroid but uh that's sort of uh sls

2372
01:29:21,590 --> 01:29:19,520
and orion in a nutshell perfect we have

2373
01:29:25,430 --> 01:29:21,600
a question here in the middle

2374
01:29:27,350 --> 01:29:25,440
yeah um other than budget what are the

2375
01:29:29,350 --> 01:29:27,360
biggest political hurdles that the

2376
01:29:31,590 --> 01:29:29,360
organization faces and how can we all

2377
01:29:33,270 --> 01:29:31,600
help um

2378
01:29:34,550 --> 01:29:33,280
you know i can't tell you to go talk to

2379
01:29:37,110 --> 01:29:34,560
your congressman but talk to your

2380
01:29:39,830 --> 01:29:37,120
congressmen and senators

2381
01:29:41,830 --> 01:29:39,840
yeah the political hurdle right now is

2382
01:29:43,830 --> 01:29:41,840
is the same thing that all of you face

2383
01:29:44,790 --> 01:29:43,840
as american citizens you want things

2384
01:29:48,470 --> 01:29:44,800
done

2385
01:29:49,270 --> 01:29:48,480
and um we just need we need for all of

2386
01:29:51,669 --> 01:29:49,280
us

2387
01:29:52,390 --> 01:29:51,679
both the administration and the congress

2388
01:29:56,950 --> 01:29:52,400

to

2389
01:29:58,629 --> 01:29:56,960
future focus on what it is that that

2390
01:30:01,270 --> 01:29:58,639
made america great and will keep us

2391
01:30:02,070 --> 01:30:01,280
great um at the pace we're going right

2392
01:30:02,950 --> 01:30:02,080
now

2393
01:30:04,149 --> 01:30:02,960
um

2394
01:30:07,030 --> 01:30:04,159
you know we

2395
01:30:08,950 --> 01:30:07,040
we we stand in jeopardy of not being the

2396
01:30:11,590 --> 01:30:08,960
great nation that we always have been

2397
01:30:13,590 --> 01:30:11,600
and that that all of us expect to be so

2398
01:30:15,669 --> 01:30:13,600
i'm certain that uh

2399
01:30:17,750 --> 01:30:15,679
that the political powers here in town

2400
01:30:19,350 --> 01:30:17,760
will come together over time you can

2401
01:30:21,110 --> 01:30:19,360
already hear

2402
01:30:22,550 --> 01:30:21,120
conversation and inklings that people

2403
01:30:24,550 --> 01:30:22,560
are starting to realize that you know

2404
01:30:25,990 --> 01:30:24,560
there are important things to be done

2405
01:30:28,070 --> 01:30:26,000
but

2406
01:30:30,310 --> 01:30:28,080
doing things like deep space exploration

2407
01:30:32,149 --> 01:30:30,320
require willpower more than

2408
01:30:33,910 --> 01:30:32,159
more than much other things

2409
01:30:35,910 --> 01:30:33,920
we went to the moon because of uh

2410
01:30:38,149 --> 01:30:35,920
president john f kennedy who did not

2411
01:30:41,030 --> 01:30:38,159
live to see it uh but who had a vision

2412
01:30:43,110 --> 01:30:41,040
that humans should should someday and he

2413
01:30:45,270 --> 01:30:43,120

was very specific before the end of that

2414
01:30:48,390 --> 01:30:45,280
decade before the end of the 60s we

2415
01:30:50,709 --> 01:30:48,400
should go to the moon with with men then

2416
01:30:53,270 --> 01:30:50,719
and bring them safely back to earth and

2417
01:30:55,030 --> 01:30:53,280
uh this president has told us and it uh

2418
01:30:57,189 --> 01:30:55,040
he he wants it to be in his lifetime but

2419
01:31:00,470 --> 01:30:57,199
he knows it won't be in his presidency

2420
01:31:02,709 --> 01:31:00,480
because it's the 19 the 2030s and so he

2421
01:31:05,030 --> 01:31:02,719
wants us to send humans to mars and

2422
01:31:06,550 --> 01:31:05,040
bring them safely back home

2423
01:31:07,910 --> 01:31:06,560
and i think we can do that but it's

2424
01:31:09,830 --> 01:31:07,920
going to take

2425
01:31:11,669 --> 01:31:09,840
combined willpower on the part of both

2426
01:31:13,990 --> 01:31:11,679
the administration the congress or all

2427
01:31:15,030 --> 01:31:14,000
three the administration the congress

2428
01:31:17,430 --> 01:31:15,040
and the

2429
01:31:20,310 --> 01:31:17,440
public not the american public but the

2430
01:31:23,030 --> 01:31:20,320
world public this is not going to be uh

2431
01:31:24,709 --> 01:31:23,040
a u.s venture we'll lead it but but we

2432
01:31:26,709 --> 01:31:24,719
can't do it without the assistance of

2433
01:31:28,070 --> 01:31:26,719
other nations

2434
01:31:30,229 --> 01:31:28,080
charlie i know you have administrator

2435
01:31:31,910 --> 01:31:30,239
things to do so i'll let you go go run

2436
01:31:33,669 --> 01:31:31,920
back to running now thank you all very

2437
01:31:40,790 --> 01:31:33,679
much thank you

2438
01:31:44,149 --> 01:31:42,070

all right so that's going to conclude

2439
01:31:46,470 --> 01:31:44,159
today's event as i said at the outset it

2440
01:31:48,229 --> 01:31:46,480
was it's a very special day uh in recent

2441
01:31:50,950 --> 01:31:48,239
nasa history this first anniversary of

2442
01:31:52,870 --> 01:31:50,960
curiosity's landing on mars for all the

2443
01:31:54,709 --> 01:31:52,880
things we talked about for for more

2444
01:31:56,709 --> 01:31:54,719
curiosity science for the follow-on

2445
01:31:58,790 --> 01:31:56,719
missions like maven that are coming for

2446
01:31:59,910 --> 01:31:58,800
new nasa technologies and development to

2447
01:32:02,870 --> 01:31:59,920
keep up with the international space

2448
01:32:04,229 --> 01:32:02,880
station crew please visit nasa.gov for

2449
01:32:05,750 --> 01:32:04,239
that and more

2450
01:32:07,430 --> 01:32:05,760
you can find all the ways to connect

2451
01:32:09,189 --> 01:32:07,440
with us and engage with us on social

2452
01:32:11,830 --> 01:32:09,199
media still and continue this

2453
01:32:14,070 --> 01:32:11,840
conversation at nasa.gov connect of

2454
01:32:16,950 --> 01:32:14,080
course you can find us at mars and at

2455
01:32:18,870 --> 01:32:16,960
excuse me at nasa mars curiosity on

2456
01:32:20,629 --> 01:32:18,880
twitter and the the hashtag we'll be

2457
01:32:22,550 --> 01:32:20,639
using is one year on mars to continue

2458
01:32:25,030 --> 01:32:22,560
the conversation about this special

2459
01:32:26,709 --> 01:32:25,040
event so that's going to do it from nasa