



1
00:10:12,480 --> 00:10:19,750
curiosity

2
00:10:19,760 --> 00:10:43,509
good shots

3
00:10:49,509 --> 00:10:46,550
i'm dan the police

4
00:10:52,150 --> 00:10:49,519
i'm jake gales chief scientist on behalf

5
00:10:54,310 --> 00:10:52,160
of jpl's leadership team i'd like to

6
00:10:57,350 --> 00:10:54,320
welcome you to our celebration of

7
00:11:00,710 --> 00:10:57,360
curiosity one year on mars

8
00:11:03,269 --> 00:11:00,720
one year ago today believe it or not

9
00:11:06,069 --> 00:11:03,279
began one of the most daring adventures

10
00:11:07,750 --> 00:11:06,079
yet in planetary exploration certainly

11
00:11:10,790 --> 00:11:07,760
the most daring

12
00:11:12,949 --> 00:11:10,800
of our exploration steps for mars

13
00:11:15,350 --> 00:11:12,959

the thrill of the curiosity rover and

14

00:11:17,110 --> 00:11:15,360

its science payload hurtling toward the

15

00:11:19,910 --> 00:11:17,120

planet to a

16

00:11:21,430 --> 00:11:19,920

soft touchdown on six wheels remains

17

00:11:23,910 --> 00:11:21,440

with us today

18

00:11:26,550 --> 00:11:23,920

and we're reminded just what an

19

00:11:29,750 --> 00:11:26,560

incredible science and

20

00:11:31,750 --> 00:11:29,760

engineering feat this is

21

00:11:32,550 --> 00:11:31,760

i'm impressed by

22

00:11:34,470 --> 00:11:32,560

the

23

00:11:36,389 --> 00:11:34,480

work that's been done since those

24

00:11:38,870 --> 00:11:36,399

initial moments on the surface with

25

00:11:41,350 --> 00:11:38,880

everything worked perfectly

26

00:11:44,389 --> 00:11:41,360

i'm impressed by the work that's been

27

00:11:46,630 --> 00:11:44,399

done in the first year of exploration

28

00:11:48,230 --> 00:11:46,640

and the rover's performance has just

29

00:11:51,670 --> 00:11:48,240

been i think

30

00:11:55,110 --> 00:11:51,680

in excess of what the most optimistic of

31

00:11:57,269 --> 00:11:55,120

us had imagined it might be

32

00:11:59,509 --> 00:11:57,279

while learning to operate the amazing

33

00:12:01,350 --> 00:11:59,519

machine that the rover and science

34

00:12:02,310 --> 00:12:01,360

payload are

35

00:12:04,870 --> 00:12:02,320

the

36

00:12:07,269 --> 00:12:04,880

engineers and scientists have forged a

37

00:12:08,870 --> 00:12:07,279

partnership that includes the rover

38

00:12:10,790 --> 00:12:08,880

itself

39

00:12:12,310 --> 00:12:10,800

they've been testing and they've been

40

00:12:15,910 --> 00:12:12,320

utilizing

41

00:12:17,750 --> 00:12:15,920

thousands of rover and payload functions

42

00:12:22,150 --> 00:12:17,760

and what we have today is an

43

00:12:24,870 --> 00:12:22,160

astonishingly powerful tool for science

44

00:12:27,990 --> 00:12:24,880

we've been observing we've been

45

00:12:30,069 --> 00:12:28,000

measuring we've been sampling

46

00:12:32,949 --> 00:12:30,079

and in the background

47

00:12:34,790 --> 00:12:32,959

throughout laboratories across the globe

48

00:12:36,230 --> 00:12:34,800

there have been scientists working to

49

00:12:39,509 --> 00:12:36,240

help interpret the measurements that

50

00:12:44,150 --> 00:12:41,990

i think it's important to recognize that

51
00:12:46,310 --> 00:12:44,160
the questions that we ask address some

52
00:12:49,110 --> 00:12:46,320
of the most important questions

53
00:12:51,990 --> 00:12:49,120
in science and for mars one of the great

54
00:12:53,990 --> 00:12:52,000
mysteries and that is was this planet

55
00:12:55,910 --> 00:12:54,000
ever habitable

56
00:12:58,230 --> 00:12:55,920
our celebration of the success of

57
00:13:00,710 --> 00:12:58,240
curiosity's first year

58
00:13:03,750 --> 00:13:00,720
includes the anticipation of even more

59
00:13:06,150 --> 00:13:03,760
exciting years of discovery to come

60
00:13:06,870 --> 00:13:06,160
we have three conversations today for

61
00:13:09,110 --> 00:13:06,880
you

62
00:13:12,629 --> 00:13:09,120
one is about getting the amazing rover

63
00:13:14,629 --> 00:13:12,639

to the surface and making it work

64

00:13:18,069 --> 00:13:14,639

about the science that's been

65

00:13:20,310 --> 00:13:18,079

accomplished and that cut to come

66

00:13:21,829 --> 00:13:20,320

and we conclude with a look at the

67

00:13:24,550 --> 00:13:21,839

extraordinary

68

00:13:26,790 --> 00:13:24,560

public and worldwide impact that this

69

00:13:29,350 --> 00:13:26,800

mission has had

70

00:13:31,030 --> 00:13:29,360

but before getting started i'd like to

71

00:13:32,790 --> 00:13:31,040

quickly acknowledge

72

00:13:36,470 --> 00:13:32,800

the past and present leaders of

73

00:13:42,150 --> 00:13:38,629

the project managers

74

00:13:42,870 --> 00:13:42,160

are mike sander pete tysinger richard

75

00:13:45,670 --> 00:13:42,880

cook

76

00:13:48,470 --> 00:13:45,680

and jim erickson and project scientist

77

00:14:06,389 --> 00:13:48,480

ed stolper and john grotzinger

78

00:14:11,189 --> 00:14:08,310

and i'd ask

79

00:14:12,710 --> 00:14:11,199

everyone who has been part of this

80

00:14:16,150 --> 00:14:12,720

amazing mission

81

00:14:18,710 --> 00:14:16,160

to please stand and be acknowledged

82

00:14:20,710 --> 00:14:18,720

please stand those of you have been part

83

00:14:37,189 --> 00:14:20,720

of this mission and worked

84

00:14:41,750 --> 00:14:39,509

so to frame our first conversation

85

00:14:43,430 --> 00:14:41,760

here's a short video that i think helped

86

00:14:44,389 --> 00:14:43,440

to remind us

87

00:14:46,870 --> 00:14:44,399

what

88

00:14:54,629 --> 00:14:46,880

it took to get to the surface of mars

89

00:14:58,550 --> 00:14:57,269

that great things

90

00:15:00,790 --> 00:14:58,560

take

91

00:15:03,030 --> 00:15:00,800

many people working together to make

92

00:15:05,189 --> 00:15:03,040

them happen is one of the fantastic

93

00:15:07,030 --> 00:15:05,199

things of human existence

94

00:15:08,710 --> 00:15:07,040

we've not only driven the rover we've

95

00:15:10,470 --> 00:15:08,720

removed its arm put it all through its

96

00:15:12,949 --> 00:15:10,480

paces but it's been in a thermal vacuum

97

00:15:14,629 --> 00:15:12,959

chamber kept very cold if parts of it

98

00:15:17,110 --> 00:15:14,639

have been a centrifuge

99

00:15:20,069 --> 00:15:17,120

we've done drop tests pull tests drive

100

00:15:21,670 --> 00:15:20,079

tests load tests stress tests

101
00:15:23,590 --> 00:15:21,680
it's just an amazing amount of testing

102
00:15:25,189 --> 00:15:23,600
this vehicle has gone through we've

103
00:15:27,189 --> 00:15:25,199
tried every way of operating at the

104
00:15:29,670 --> 00:15:27,199
vehicle using the software literally

105
00:15:31,430 --> 00:15:29,680
thousands and thousands of hours of

106
00:15:34,310 --> 00:15:31,440
software testing

107
00:15:36,949 --> 00:15:34,320
it's been just a an amazing several

108
00:15:38,790 --> 00:15:36,959
years really of constant testing and

109
00:15:40,389 --> 00:15:38,800
development finding problems fixing

110
00:15:45,509 --> 00:15:40,399
those problems and going on to the next

111
00:15:54,949 --> 00:15:48,150
you'll see this is the Id on channel one

112
00:15:58,150 --> 00:15:56,550
am i confident that she's going to go

113
00:15:59,670 --> 00:15:58,160

and she's going to be successful

114

00:16:06,150 --> 00:15:59,680

absolutely

115

00:16:09,110 --> 00:16:07,829

we should have fair deploy around mach

116

00:16:11,430 --> 00:16:09,120

1.7

117

00:16:16,470 --> 00:16:11,440

the parachute is deployed

118

00:16:22,550 --> 00:16:18,389

has separated on the ground

119

00:16:25,829 --> 00:16:24,150

we are in power twice we're an altitude

120

00:16:36,470 --> 00:16:25,839

of one kilometer descending by

121

00:16:36,480 --> 00:16:57,590

touchdown

122

00:17:03,590 --> 00:17:00,150

what a fantastic demonstration of what

123

00:17:05,669 --> 00:17:03,600

our nation and our agency can do

124

00:17:07,909 --> 00:17:05,679

i could only think of the words of teddy

125

00:17:09,990 --> 00:17:07,919

roosevelt as i was sitting there

126

00:17:12,390 --> 00:17:10,000

it is far better to their mighty things

127

00:17:14,390 --> 00:17:12,400

even though we might fail

128

00:17:17,029 --> 00:17:14,400

than to stay in the twilight that knows

129

00:17:34,310 --> 00:17:17,039

neither victory nor defeat and the team

130

00:17:38,870 --> 00:17:36,390

so i'd like to introduce the host of

131

00:17:41,110 --> 00:17:38,880

today's first conversation

132

00:17:43,029 --> 00:17:41,120

the man who led the project that put

133

00:17:44,830 --> 00:17:43,039

spirit and opportunity

134

00:17:47,830 --> 00:17:44,840

on the surface of mars in

135

00:17:50,470 --> 00:17:47,840

2004 and again delivered the curiosity

136

00:18:01,669 --> 00:17:50,480

rover to mars in 2012.

137

00:18:05,029 --> 00:18:03,430

i really wish dan would stop reminding

138

00:18:06,310 --> 00:18:05,039

me how old i am

139

00:18:08,230 --> 00:18:06,320

um

140

00:18:09,669 --> 00:18:08,240

you know you look at that video and i

141

00:18:12,070 --> 00:18:09,679

don't know about you but i've probably

142

00:18:13,350 --> 00:18:12,080

seen that video a hundred times in the

143

00:18:16,070 --> 00:18:13,360

last year

144

00:18:18,070 --> 00:18:16,080

and you still think about how you felt

145

00:18:19,909 --> 00:18:18,080

that night and still

146

00:18:22,630 --> 00:18:19,919

in wonderment that it really did what it

147

00:18:24,630 --> 00:18:22,640

did it's it's an amazing story

148

00:18:26,310 --> 00:18:24,640

so i brought with me three of uh three

149

00:18:29,510 --> 00:18:26,320

of my cohorts to talk to you a little

150

00:18:32,230 --> 00:18:29,520

bit about uh some of the engineering uh

151

00:18:34,470 --> 00:18:32,240

stories about getting curiosity to uh to

152

00:18:36,150 --> 00:18:34,480

the launch pad and and to the planet and

153

00:18:37,350 --> 00:18:36,160

and in preparation for the surface

154

00:18:39,430 --> 00:18:37,360

operations

155

00:18:41,590 --> 00:18:39,440

to my left is matt wallace he was a

156

00:18:44,390 --> 00:18:41,600

flight system manager uh

157

00:18:46,630 --> 00:18:44,400

on on the mission uh from beginning to

158

00:18:49,350 --> 00:18:46,640

end uh which means he probably has the

159

00:18:52,150 --> 00:18:49,360

least sleep of anybody on the mission

160

00:18:54,870 --> 00:18:52,160

uh to his left is alan chen uh he was an

161

00:18:56,549 --> 00:18:54,880

engineer on adl and you may remember him

162

00:18:58,310 --> 00:18:56,559

at the night of

163

00:18:59,510 --> 00:18:58,320

curiosity's landing as being the voice

164

00:19:01,510 --> 00:18:59,520

of edl

165

00:19:03,510 --> 00:19:01,520

i think he said something like uh we're

166

00:19:04,630 --> 00:19:03,520

on mars everybody that was a nice nice

167

00:19:05,669 --> 00:19:04,640

thing to hear

168

00:19:08,150 --> 00:19:05,679

uh

169

00:19:09,270 --> 00:19:08,160

and then and to the far left is jessica

170

00:19:10,870 --> 00:19:09,280

samuels

171

00:19:12,870 --> 00:19:10,880

she was the phase lead for surface

172

00:19:14,470 --> 00:19:12,880

operations during development and now

173

00:19:16,470 --> 00:19:14,480

leaves the engineering team and she'll

174

00:19:17,990 --> 00:19:16,480

talk a little bit about operations so

175

00:19:20,070 --> 00:19:18,000

matt

176

00:19:21,510 --> 00:19:20,080

thanks pete uh

177

00:19:23,270 --> 00:19:21,520

i know this is going to come as a shock

178

00:19:25,909 --> 00:19:23,280

to some of you but on every single

179

00:19:27,669 --> 00:19:25,919

memory i have of msl happens to be of

180

00:19:29,909 --> 00:19:27,679

sunshine and roses

181

00:19:32,150 --> 00:19:29,919

there were some tough times there

182

00:19:34,230 --> 00:19:32,160

and uh and so i thought i'd say a couple

183

00:19:35,110 --> 00:19:34,240

words about one of those periods um it

184

00:19:37,990 --> 00:19:35,120

was

185

00:19:39,909 --> 00:19:38,000

kind of late spring of 2011 and we were

186

00:19:42,710 --> 00:19:39,919

just a few months away from having to

187

00:19:44,230 --> 00:19:42,720

ship the uh the vehicle to the cape

188

00:19:47,110 --> 00:19:44,240

we had had a pretty good winter we had

189

00:19:48,870 --> 00:19:47,120

just gotten through a difficult rework

190

00:19:51,110 --> 00:19:48,880

activity on the vehicle

191

00:19:53,750 --> 00:19:51,120

we had all of our engineering hardware

192

00:19:55,750 --> 00:19:53,760

we had all of our science instruments

193

00:19:57,029 --> 00:19:55,760

finally on the vehicle it was up it was

194

00:19:58,789 --> 00:19:57,039

running

195

00:20:00,310 --> 00:19:58,799

it was working as an integrated system

196

00:20:02,710 --> 00:20:00,320

we got through a

197

00:20:04,230 --> 00:20:02,720

vibration test of the vehicle curiosity

198

00:20:06,549 --> 00:20:04,240

and we took it into the chamber there

199

00:20:08,390 --> 00:20:06,559

was a quick picture in the video of the

200

00:20:11,510 --> 00:20:08,400

vehicle in the chamber

201
00:20:13,830 --> 00:20:11,520
with the simulated sun shining down on

202
00:20:16,070 --> 00:20:13,840
it and we thought perhaps you know

203
00:20:17,990 --> 00:20:16,080
the sun in fact you know was shining on

204
00:20:20,710 --> 00:20:18,000
the project at that point

205
00:20:24,150 --> 00:20:20,720
um but there were clouds on the horizon

206
00:20:26,789 --> 00:20:24,160
unfortunately and perhaps even uh some

207
00:20:29,350 --> 00:20:26,799
severe tropical storms uh

208
00:20:30,710 --> 00:20:29,360
and within a month or so as you can see

209
00:20:32,789 --> 00:20:30,720
in this picture

210
00:20:34,630 --> 00:20:32,799
the rover was up on the blocks it was

211
00:20:36,870 --> 00:20:34,640
dead bugged we had ripped some wheels

212
00:20:39,190 --> 00:20:36,880
off the belly pin was off we were

213
00:20:41,669 --> 00:20:39,200

pulling harnessing out to fix some of

214

00:20:43,110 --> 00:20:41,679

the components that needed reliability

215

00:20:45,669 --> 00:20:43,120

had some reliable

216

00:20:47,750 --> 00:20:45,679

reliability issues we were

217

00:20:49,430 --> 00:20:47,760

we were pulling boxes out because we

218

00:20:50,230 --> 00:20:49,440

were electronic boxes we were worried

219

00:20:51,750 --> 00:20:50,240

about

220

00:20:53,510 --> 00:20:51,760

some of these boxes having a noise

221

00:20:54,870 --> 00:20:53,520

vulnerability that could have ended the

222

00:20:56,230 --> 00:20:54,880

mission during the entry descent and

223

00:20:58,070 --> 00:20:56,240

landing phase

224

00:20:59,830 --> 00:20:58,080

that you saw so successfully go through

225

00:21:01,270 --> 00:20:59,840

a year ago today

226

00:21:02,950 --> 00:21:01,280

so there were some

227

00:21:04,630 --> 00:21:02,960

significant issues we were also pulling

228

00:21:06,710 --> 00:21:04,640

off our sampling system which has been

229

00:21:09,990 --> 00:21:06,720

doing such tremendous work on the

230

00:21:11,669 --> 00:21:10,000

surface of mars um over the last uh uh

231

00:21:14,710 --> 00:21:11,679

sin over the last year

232

00:21:16,310 --> 00:21:14,720

and so uh it was a tense time and and

233

00:21:17,430 --> 00:21:16,320

some of us pete and i were trying to

234

00:21:19,270 --> 00:21:17,440

figure out

235

00:21:21,029 --> 00:21:19,280

where we were going to find enough time

236

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

in the schedule to put this thing back

237

00:21:24,549 --> 00:21:23,200

together retest it

238

00:21:27,430 --> 00:21:24,559

get it down to the cape get the

239

00:21:30,470 --> 00:21:27,440

spacecraft restacked and and into the uh

240

00:21:33,110 --> 00:21:30,480

and onto the launch vehicle and i i

241

00:21:34,789 --> 00:21:33,120

remember thinking to myself

242

00:21:37,430 --> 00:21:34,799

why are we struggling here why is this

243

00:21:40,070 --> 00:21:37,440

so hard you know what do we try to do

244

00:21:42,870 --> 00:21:40,080

this to ourselves and uh

245

00:21:45,190 --> 00:21:42,880

and and after after a little bit of time

246

00:21:47,029 --> 00:21:45,200

uh thinking in hindsight in fact that

247

00:21:49,110 --> 00:21:47,039

that is exactly what we did we did

248

00:21:51,029 --> 00:21:49,120

intend to do that to ourselves and the

249

00:21:53,350 --> 00:21:51,039

reason was from the first day i i

250

00:21:55,590 --> 00:21:53,360

started working on this project

251
00:21:57,430 --> 00:21:55,600
we designed this system we architected

252
00:21:59,110 --> 00:21:57,440
it to be robust

253
00:22:02,149 --> 00:21:59,120
to be um

254
00:22:05,110 --> 00:22:02,159
reliable in flight for it to have the

255
00:22:07,350 --> 00:22:05,120
ability to uh to take a punch from mars

256
00:22:09,029 --> 00:22:07,360
and stay on its feet you know and we saw

257
00:22:10,789 --> 00:22:09,039
that a year ago when we landed we went

258
00:22:12,549 --> 00:22:10,799
right down the middle we had a very

259
00:22:13,830 --> 00:22:12,559
successful landing

260
00:22:17,029 --> 00:22:13,840
and we've been watching that on the

261
00:22:18,950 --> 00:22:17,039
surface of mars i think this is a very

262
00:22:20,149 --> 00:22:18,960
um this is a this is a vehicle that

263
00:22:23,270 --> 00:22:20,159

likes to be

264

00:22:26,549 --> 00:22:23,280

on its way or on the surface of mars and

265

00:22:28,870 --> 00:22:26,559

uh the the corollary to that of course

266

00:22:30,230 --> 00:22:28,880

is that it makes it you may have to

267

00:22:31,750 --> 00:22:30,240

build some very

268

00:22:33,190 --> 00:22:31,760

uh difficult things you may have to

269

00:22:34,070 --> 00:22:33,200

design and build some very difficult

270

00:22:37,430 --> 00:22:34,080

things

271

00:22:39,190 --> 00:22:37,440

and uh and fortunately um we have uh we

272

00:22:42,310 --> 00:22:39,200

had a very uh

273

00:22:44,630 --> 00:22:42,320

strong and resilient team to do that

274

00:22:46,710 --> 00:22:44,640

and and that was at that period of time

275

00:22:48,789 --> 00:22:46,720

really called uh called on that team to

276

00:22:50,870 --> 00:22:48,799

do everything they could to get through

277

00:22:53,190 --> 00:22:50,880

that rebuild cycle

278

00:22:55,669 --> 00:22:53,200

as you can see here get the vehicle back

279

00:22:58,230 --> 00:22:55,679

together and get it down to the cape and

280

00:23:00,950 --> 00:22:58,240

and eventually in the next image um you

281

00:23:03,510 --> 00:23:00,960

can see the spacecraft fully assembled

282

00:23:05,830 --> 00:23:03,520

ready for encapsulation uh

283

00:23:09,110 --> 00:23:05,840

inside the uh the launch vehicle

284

00:23:10,789 --> 00:23:09,120

uh so uh it it was uh

285

00:23:13,029 --> 00:23:10,799

you know the the project brought all

286

00:23:15,669 --> 00:23:13,039

kinds of challenges absolutely but uh

287

00:23:17,909 --> 00:23:15,679

the story ends well as you all know

288

00:23:19,590 --> 00:23:17,919

and uh and and i want to once again just

289

00:23:22,149 --> 00:23:19,600

thank the the team here and at the

290

00:23:23,990 --> 00:23:22,159

various centers uh out in industry our

291

00:23:27,270 --> 00:23:24,000

international partners everybody that

292

00:23:29,750 --> 00:23:27,280

really made this uh this possible so

293

00:23:31,830 --> 00:23:29,760

thanks peter thank you man

294

00:23:33,750 --> 00:23:31,840

um of course that was only one of the of

295

00:23:35,430 --> 00:23:33,760

the many stories and challenges that uh

296

00:23:36,470 --> 00:23:35,440

that happened to curiosity on the way to

297

00:23:38,870 --> 00:23:36,480

florida

298

00:23:41,270 --> 00:23:38,880

i can remember

299

00:23:42,630 --> 00:23:41,280

talking with matt and and dave rule the

300

00:23:44,470 --> 00:23:42,640

head of atlo and

301
00:23:45,830 --> 00:23:44,480
talking about including rework periods

302
00:23:47,110 --> 00:23:45,840
in the outlook schedule because we knew

303
00:23:48,310 --> 00:23:47,120
we were going to have problem failure

304
00:23:50,390 --> 00:23:48,320
reports we knew that some of those were

305
00:23:51,750 --> 00:23:50,400
going to require hardware changes and

306
00:23:53,750 --> 00:23:51,760
we thought we would you know

307
00:23:55,830 --> 00:23:53,760
pre-schedule some of that thing and and

308
00:23:58,390 --> 00:23:55,840
so we put the uh

309
00:23:59,909 --> 00:23:58,400
one of the we put a reworked period in

310
00:24:01,750 --> 00:23:59,919
the outlook schedule and and the

311
00:24:04,070 --> 00:24:01,760
incident that matt talked about was

312
00:24:05,909 --> 00:24:04,080
number three of the one uh at low rework

313
00:24:06,710 --> 00:24:05,919

period that we had

314

00:24:08,710 --> 00:24:06,720

um

315

00:24:10,390 --> 00:24:08,720

i wanna i wanna uh echo max

316

00:24:11,990 --> 00:24:10,400

congratulations to the team that not

317

00:24:13,990 --> 00:24:12,000

only worked on the design of curiosity

318

00:24:15,990 --> 00:24:14,000

but also the atlo team

319

00:24:18,149 --> 00:24:16,000

that in so many of our missions uh save

320

00:24:20,549 --> 00:24:18,159

our our behinds because of the ability

321

00:24:23,029 --> 00:24:20,559

to compress schedule at the very end

322

00:24:25,350 --> 00:24:23,039

and also to the kennedy team who uh

323

00:24:26,710 --> 00:24:25,360

who uh in in in preparation of the

324

00:24:29,350 --> 00:24:26,720

fairing which had to be cleaned for

325

00:24:31,029 --> 00:24:29,360

planetary protection purposes and also

326

00:24:32,950 --> 00:24:31,039

in uh in the last integration of the

327

00:24:34,789 --> 00:24:32,960

vehicle did a fantastic job so that we

328

00:24:37,029 --> 00:24:34,799

launched in fact on the second

329

00:24:38,950 --> 00:24:37,039

geometrical opportunity and it was a it

330

00:24:40,470 --> 00:24:38,960

was a very successful launch

331

00:24:42,630 --> 00:24:40,480

and that got us into cruise and of

332

00:24:44,070 --> 00:24:42,640

course you might think that that

333

00:24:46,789 --> 00:24:44,080

would have been an easy time but it was

334

00:24:47,990 --> 00:24:46,799

not really um we had we had flight

335

00:24:49,590 --> 00:24:48,000

software to

336

00:24:52,310 --> 00:24:49,600

to to do because we had the late flight

337

00:24:54,789 --> 00:24:52,320

software development we had a few cruise

338

00:24:57,190 --> 00:24:54,799

things to worry about we had the uh

339

00:24:58,549 --> 00:24:57,200

we had a computer issue early on that

340

00:25:00,549 --> 00:24:58,559

that we solved with the help with the

341

00:25:02,470 --> 00:25:00,559

help of our baa partner

342

00:25:04,230 --> 00:25:02,480

and then we got to edl and alan we'll

343

00:25:05,750 --> 00:25:04,240

talk a little bit about that

344

00:25:07,269 --> 00:25:05,760

uh since it's been the year since

345

00:25:09,029 --> 00:25:07,279

landing i figured it would be a good

346

00:25:10,230 --> 00:25:09,039

time to make a bit of a public

347

00:25:11,350 --> 00:25:10,240

confession

348

00:25:13,110 --> 00:25:11,360

um

349

00:25:15,190 --> 00:25:13,120

as pete mentioned i you know i had the

350

00:25:16,789 --> 00:25:15,200

honor of uh doing the play-by-play on

351
00:25:18,950 --> 00:25:16,799
the way down i kind of gave myself two

352
00:25:20,789 --> 00:25:18,960
guidelines uh one was to try not to say

353
00:25:22,390 --> 00:25:20,799
anything stupid and the second was to

354
00:25:23,909 --> 00:25:22,400
try to report what i saw and report

355
00:25:26,549 --> 00:25:23,919
everything i saw and it's actually that

356
00:25:28,310 --> 00:25:26,559
second one which i didn't do

357
00:25:30,149 --> 00:25:28,320
it turns out uh you know if you're

358
00:25:32,230 --> 00:25:30,159
taking you back to that night uh a year

359
00:25:33,590 --> 00:25:32,240
ago um you know we were watching

360
00:25:35,669 --> 00:25:33,600
telemetry coming in from the vehicle and

361
00:25:38,710 --> 00:25:35,679
we had two types we had these tones at

362
00:25:41,029 --> 00:25:38,720
the one of these 256 notes that the the

363
00:25:42,549 --> 00:25:41,039

the uh that curiosity would send back to

364

00:25:44,710 --> 00:25:42,559

us to tell us what was going on and

365

00:25:46,710 --> 00:25:44,720

that's all we had for about you know 14

366

00:25:48,390 --> 00:25:46,720

15 minutes from around cruise stage

367

00:25:49,909 --> 00:25:48,400

separation until we got into the

368

00:25:53,110 --> 00:25:49,919

atmosphere and then after that we

369

00:25:54,710 --> 00:25:53,120

started picking up data from odyssey

370

00:25:56,230 --> 00:25:54,720

it's those tones that you know things

371

00:25:58,230 --> 00:25:56,240

were looking pretty good for a long time

372

00:26:00,390 --> 00:25:58,240

uh you know we had 10 minutes of pretty

373

00:26:01,830 --> 00:26:00,400

boring heartbeat tones i was like

374

00:26:03,510 --> 00:26:01,840

my blood pressure was up but you know

375

00:26:05,110 --> 00:26:03,520

let's just calm it down a little bit

376

00:26:07,350 --> 00:26:05,120

then uh shortly after we hit the

377

00:26:09,590 --> 00:26:07,360

atmosphere we got a tone called uh

378

00:26:12,470 --> 00:26:09,600

mead's beta catastrophic

379

00:26:15,510 --> 00:26:12,480

um usually bad when you get these these

380

00:26:16,870 --> 00:26:15,520

tones that come back saying catastrophic

381

00:26:18,630 --> 00:26:16,880

you know we had intended that tone to

382

00:26:19,990 --> 00:26:18,640

tell us that we were about to imminently

383

00:26:21,190 --> 00:26:20,000

lose the vehicle

384

00:26:23,110 --> 00:26:21,200

these were

385

00:26:23,990 --> 00:26:23,120

it was based on you had to do a lot of

386

00:26:26,630 --> 00:26:24,000

processing because you couldn't send

387

00:26:28,549 --> 00:26:26,640

back raw telemetry in these tones

388

00:26:29,590 --> 00:26:28,559

and uh you know that really spiked my

389

00:26:31,430 --> 00:26:29,600

blood pressure i think i almost had a

390

00:26:33,269 --> 00:26:31,440

heart attack when i saw that

391

00:26:35,750 --> 00:26:33,279

you know what that meant was you know if

392

00:26:37,110 --> 00:26:35,760

it was true was that the the vehicle was

393

00:26:39,190 --> 00:26:37,120

either tumbling

394

00:26:41,430 --> 00:26:39,200

or not heat shield forward

395

00:26:42,630 --> 00:26:41,440

toward the atmosphere we was using

396

00:26:44,310 --> 00:26:42,640

it's using the sensors actually you can

397

00:26:45,909 --> 00:26:44,320

see them on heat shield there

398

00:26:47,190 --> 00:26:45,919

these pressure sensors to try to guess

399

00:26:48,630 --> 00:26:47,200

try to figure out what the attitude of

400

00:26:49,750 --> 00:26:48,640

the vehicle was

401
00:26:51,110 --> 00:26:49,760
um so

402
00:26:52,789 --> 00:26:51,120
i bet if you watch i haven't gone back

403
00:26:54,870 --> 00:26:52,799
and re-watched the video i can't stand

404
00:26:56,149 --> 00:26:54,880
watching myself but uh

405
00:26:58,950 --> 00:26:56,159
i bet if you go back and watch it you

406
00:27:01,029 --> 00:26:58,960
can probably see me seize up um i'm a

407
00:27:02,630 --> 00:27:01,039
terrible poker player and uh

408
00:27:03,830 --> 00:27:02,640
you know it's uh

409
00:27:06,149 --> 00:27:03,840
yeah that was definitely a

410
00:27:07,430 --> 00:27:06,159
heart-stopping moment for me and i

411
00:27:09,750 --> 00:27:07,440
thought about it for a second you know i

412
00:27:10,950 --> 00:27:09,760
had figured you know if uh

413
00:27:12,470 --> 00:27:10,960

you know if about to lose the vehicle i

414

00:27:15,830 --> 00:27:12,480

better not say anything dumb there back

415

00:27:17,590 --> 00:27:15,840

to guideline one um so

416

00:27:18,630 --> 00:27:17,600

yeah i was like you know this this just

417

00:27:19,990 --> 00:27:18,640

happened right after we hit the

418

00:27:22,470 --> 00:27:20,000

atmosphere there really shouldn't be

419

00:27:24,549 --> 00:27:22,480

much air at that point do i really

420

00:27:26,149 --> 00:27:24,559

believe this you know is there is there

421

00:27:28,230 --> 00:27:26,159

something going on here that's uh that's

422

00:27:30,710 --> 00:27:28,240

more than more than i was thinking about

423

00:27:31,669 --> 00:27:30,720

um you know because it's it's using uh

424

00:27:32,950 --> 00:27:31,679

you know it's trying to basically

425

00:27:33,990 --> 00:27:32,960

subtract off the pressures from two

426

00:27:35,669 --> 00:27:34,000

different sides of the heat shield to

427

00:27:37,269 --> 00:27:35,679

figure out what the attitude is but

428

00:27:38,870 --> 00:27:37,279

really there's not much air up there are

429

00:27:39,909 --> 00:27:38,880

we getting much pressure at all what's

430

00:27:41,909 --> 00:27:39,919

going on

431

00:27:43,190 --> 00:27:41,919

um so i figured let me sit on this one

432

00:27:44,710 --> 00:27:43,200

for a minute if we're about to lose the

433

00:27:46,310 --> 00:27:44,720

vehicle if we're about to you know we're

434

00:27:47,350 --> 00:27:46,320

about to hit peak deceleration and peak

435

00:27:48,230 --> 00:27:47,360

heating it's going to become pretty

436

00:27:49,830 --> 00:27:48,240

obvious if we're going to lose the

437

00:27:51,110 --> 00:27:49,840

vehicle in a minute or two

438

00:27:56,389 --> 00:27:51,120

um

439

00:27:58,470 --> 00:27:56,399

luckily everything else turned out okay

440

00:28:00,310 --> 00:27:58,480

um you know it turns out actually that

441

00:28:02,389 --> 00:28:00,320

the instrument is working fine but the

442

00:28:04,070 --> 00:28:02,399

uh if we just had a calibration error

443

00:28:06,549 --> 00:28:04,080

and how i was going about it

444

00:28:08,230 --> 00:28:06,559

um but uh yeah if i wasn't already

445

00:28:09,909 --> 00:28:08,240

sweating a lot then then i was super

446

00:28:12,230 --> 00:28:09,919

sweating after that

447

00:28:14,230 --> 00:28:12,240

definitely had the heart pounding so

448

00:28:16,070 --> 00:28:14,240

but you know as i like to say edl is

449

00:28:17,669 --> 00:28:16,080

really just the uh the middle of the

450

00:28:19,750 --> 00:28:17,679

story or even closer to the beginning

451
00:28:21,190 --> 00:28:19,760
really uh it's what's happened afterward

452
00:28:22,789 --> 00:28:21,200
that's kind of been the most rewarding

453
00:28:24,710 --> 00:28:22,799
for me

454
00:28:27,430 --> 00:28:24,720
thanks alan um

455
00:28:28,830 --> 00:28:27,440
i'm glad you didn't tell me

456
00:28:31,110 --> 00:28:28,840
i didn't want to kill

457
00:28:32,870 --> 00:28:31,120
anybody and given all the taxes given

458
00:28:34,389 --> 00:28:32,880
all the vips that were there that night

459
00:28:36,950 --> 00:28:34,399
i'm glad you exercised a measure of

460
00:28:41,110 --> 00:28:39,350
and for all that work for the seven

461
00:28:43,029 --> 00:28:41,120
years to get to that point in time for

462
00:28:46,070 --> 00:28:43,039
all the risk reduction that had happened

463
00:28:48,950 --> 00:28:46,080

all the the risk reduction during design

464

00:28:50,630 --> 00:28:48,960

and during assembly and and the fact of

465

00:28:52,470 --> 00:28:50,640

launch which has its own

466

00:28:54,950 --> 00:28:52,480

issues and crews

467

00:28:57,510 --> 00:28:54,960

and edl and we're finally on the surface

468

00:28:59,350 --> 00:28:57,520

and you need to realize at that point

469

00:29:01,909 --> 00:28:59,360

in your book that you're reading you've

470

00:29:02,789 --> 00:29:01,919

just passed the prologue

471

00:29:05,269 --> 00:29:02,799

okay

472

00:29:06,710 --> 00:29:05,279

because we do all that work

473

00:29:08,549 --> 00:29:06,720

so that the surface science and the

474

00:29:09,830 --> 00:29:08,559

service operations take place and

475

00:29:12,230 --> 00:29:09,840

jessica will talk a little bit about

476

00:29:14,230 --> 00:29:12,240

that so we've really been having an

477

00:29:17,909 --> 00:29:14,240

exciting time on the surface in this

478

00:29:20,549 --> 00:29:17,919

past year we've sent over 15 000

479

00:29:24,389 --> 00:29:20,559

commands to the rover so far with an

480

00:29:27,029 --> 00:29:24,399

average of 600 to 800 commands a day

481

00:29:27,990 --> 00:29:27,039

which is a pretty impressive and our

482

00:29:30,630 --> 00:29:28,000

five

483

00:29:32,789 --> 00:29:30,640

samples that we've scooped and uh two

484

00:29:34,470 --> 00:29:32,799

drill rock targets where we delivered

485

00:29:37,590 --> 00:29:34,480

those samples to our analytical

486

00:29:38,950 --> 00:29:37,600

instruments and uh we're approaching two

487

00:29:40,710 --> 00:29:38,960

kilometers or about one and three

488

00:29:42,470 --> 00:29:40,720

quarter kilometers

489

00:29:44,789 --> 00:29:42,480

and the countless number of science

490

00:29:45,909 --> 00:29:44,799

papers that the science team has been

491

00:29:48,950 --> 00:29:45,919

able to

492

00:29:50,630 --> 00:29:48,960

uh draft and present um has really been

493

00:29:52,870 --> 00:29:50,640

a testament to how much we've been able

494

00:29:54,710 --> 00:29:52,880

to exercise the capabilities all the

495

00:29:57,590 --> 00:29:54,720

capabilities of this vehicle

496

00:29:59,669 --> 00:29:57,600

um so we've been having a great time on

497

00:30:03,190 --> 00:29:59,679

the surface but kind of keeping in line

498

00:30:05,669 --> 00:30:03,200

with these challenges um our our pro

499

00:30:06,710 --> 00:30:05,679

probably our biggest challenge arise

500

00:30:09,430 --> 00:30:06,720

about

501
00:30:11,750 --> 00:30:09,440
halfway into the year um we had just

502
00:30:14,950 --> 00:30:11,760
finished our first drill sample

503
00:30:15,830 --> 00:30:14,960
um at the john klein science target and

504
00:30:18,470 --> 00:30:15,840
uh

505
00:30:20,549 --> 00:30:18,480
had delivered um some of those

506
00:30:23,510 --> 00:30:20,559
samples to the science instruments

507
00:30:25,510 --> 00:30:23,520
um but uh on one of the afternoons when

508
00:30:27,190 --> 00:30:25,520
we received the data we were

509
00:30:28,950 --> 00:30:27,200
we saw that we actually weren't getting

510
00:30:30,789 --> 00:30:28,960
data products from the spacecraft and

511
00:30:32,470 --> 00:30:30,799
that's one of the main ways that we get

512
00:30:33,510 --> 00:30:32,480
the telemetry from what's happening on

513
00:30:35,909 --> 00:30:33,520

the rover

514

00:30:37,990 --> 00:30:35,919

and uh and it was kind of convoluted

515

00:30:39,990 --> 00:30:38,000

with you know rain and spain at the dsn

516

00:30:41,669 --> 00:30:40,000

and so it was a little hard to to make

517

00:30:43,269 --> 00:30:41,679

out what was going on with the data but

518

00:30:46,070 --> 00:30:43,279

we have a second overflight from the

519

00:30:47,590 --> 00:30:46,080

odyssey orbiter and and that data also

520

00:30:50,230 --> 00:30:47,600

showed us that the rover hadn't gone to

521

00:30:53,510 --> 00:30:50,240

sleep um in between the two times um

522

00:30:57,190 --> 00:30:53,520

from the mro pass and this odyssey pass

523

00:30:59,110 --> 00:30:57,200

so that got people worried and uh the

524

00:31:01,750 --> 00:30:59,120

conclusion was that the spacecraft

525

00:31:03,510 --> 00:31:01,760

really wasn't operating how we were

526
00:31:07,029 --> 00:31:03,520
expecting it to and it wasn't performing

527
00:31:09,990 --> 00:31:07,039
its nominal functions so after a very

528
00:31:11,909 --> 00:31:10,000
long day and night and commanding into

529
00:31:13,909 --> 00:31:11,919
the middle of the night and we weren't

530
00:31:15,830 --> 00:31:13,919
uh we were no longer on mars time so

531
00:31:16,789 --> 00:31:15,840
everybody had already been there a long

532
00:31:18,870 --> 00:31:16,799
day

533
00:31:20,789 --> 00:31:18,880
the team concluded that the most

534
00:31:23,110 --> 00:31:20,799
important thing was to get it back into

535
00:31:24,950 --> 00:31:23,120
the configuration that we know which is

536
00:31:26,710 --> 00:31:24,960
to swap the computers from

537
00:31:27,830 --> 00:31:26,720
the a side computer over to the b-side

538
00:31:29,510 --> 00:31:27,840

computer

539

00:31:31,110 --> 00:31:29,520

and

540

00:31:33,110 --> 00:31:31,120

all this was happening

541

00:31:34,789 --> 00:31:33,120

and you know surface being this mission

542

00:31:37,110 --> 00:31:34,799

of you know science discovery and being

543

00:31:38,950 --> 00:31:37,120

led by whatever um

544

00:31:40,789 --> 00:31:38,960

you know is in front of you i don't know

545

00:31:42,950 --> 00:31:40,799

if the team was just nostalgic for a

546

00:31:44,870 --> 00:31:42,960

deadline um because you know launch

547

00:31:45,909 --> 00:31:44,880

happened and cruise happened orlando

548

00:31:48,470 --> 00:31:45,919

happened

549

00:31:50,789 --> 00:31:48,480

uh we had solar conjunction happening

550

00:31:52,789 --> 00:31:50,799

within a month um from when this event

551
00:31:54,950 --> 00:31:52,799
occurred which meant we weren't going to

552
00:31:57,029 --> 00:31:54,960
see um we weren't going to be able to

553
00:31:58,230 --> 00:31:57,039
command um or really hear from the

554
00:31:59,029 --> 00:31:58,240
spacecraft

555
00:32:01,669 --> 00:31:59,039
in

556
00:32:03,750 --> 00:32:01,679
for about three weeks over um the month

557
00:32:06,149 --> 00:32:03,760
of april so

558
00:32:08,149 --> 00:32:06,159
so here we were in march

559
00:32:09,909 --> 00:32:08,159
the team pulled together

560
00:32:11,669 --> 00:32:09,919
we had members

561
00:32:12,950 --> 00:32:11,679
past team members and current team

562
00:32:15,029 --> 00:32:12,960
members

563
00:32:16,789 --> 00:32:15,039

really coming together stepping up and

564

00:32:18,470 --> 00:32:16,799

doing all kinds of different jobs

565

00:32:20,149 --> 00:32:18,480

everybody kind of broke out into

566

00:32:23,110 --> 00:32:20,159

investigating the hardware side of what

567

00:32:25,350 --> 00:32:23,120

was going on in the software side

568

00:32:27,590 --> 00:32:25,360

and the ops process was even you know

569

00:32:30,630 --> 00:32:27,600

revamped to figure out how to channel or

570

00:32:34,310 --> 00:32:30,640

how to adapt to the anomaly at hand

571

00:32:36,710 --> 00:32:34,320

and just seeing the team come together

572

00:32:39,190 --> 00:32:36,720

like that i think was just a testament

573

00:32:41,669 --> 00:32:39,200

to the integrity and

574

00:32:44,230 --> 00:32:41,679

the commitment that we all have on these

575

00:32:46,470 --> 00:32:44,240

types of missions where you know you

576

00:32:49,350 --> 00:32:46,480

come back and you you know put

577

00:32:50,470 --> 00:32:49,360

put forward what uh what you bring what

578

00:32:51,509 --> 00:32:50,480

you know

579

00:32:55,269 --> 00:32:51,519

and

580

00:32:57,830 --> 00:32:55,279

i think

581

00:33:00,710 --> 00:32:57,840

being able to experience that and seeing

582

00:33:03,669 --> 00:33:00,720

all the faces kind of um bring their

583

00:33:05,509 --> 00:33:03,679

piece to the table was um was pretty

584

00:33:07,830 --> 00:33:05,519

exciting to go through that kind of

585

00:33:09,269 --> 00:33:07,840

harrowing time where we were against the

586

00:33:12,149 --> 00:33:09,279

clock

587

00:33:14,470 --> 00:33:12,159

so we recovered in a couple weeks and

588

00:33:16,149 --> 00:33:14,480

got science back up and running and we

589

00:33:17,750 --> 00:33:16,159

modified the flight software to be more

590

00:33:20,549 --> 00:33:17,760

robust and so going into that

591

00:33:22,789 --> 00:33:20,559

conjunction period and we were prepared

592

00:33:24,389 --> 00:33:22,799

and should have a problem like this

593

00:33:27,909 --> 00:33:24,399

happen again on the other computer that

594

00:33:30,389 --> 00:33:27,919

we're operating on but um but aside from

595

00:33:32,789 --> 00:33:30,399

that one you know kind of scary moment

596

00:33:34,710 --> 00:33:32,799

there the surface operation has just

597

00:33:38,230 --> 00:33:34,720

been fantastic in terms of what we're

598

00:33:39,190 --> 00:33:38,240

learning and uh and just all the the

599

00:33:41,590 --> 00:33:39,200

different

600

00:33:43,990 --> 00:33:41,600

uh suite of capabilities that this rover

601
00:33:47,350 --> 00:33:44,000
has that's first time ever on mars stuff

602
00:33:49,750 --> 00:33:47,360
that we're doing so it's been pretty fun

603
00:33:52,310 --> 00:33:49,760
thank you jessica um i hadn't known it

604
00:33:53,669 --> 00:33:52,320
was a stormy night when that happened

605
00:33:55,990 --> 00:33:53,679
those of us that lived through the sole

606
00:33:59,029 --> 00:33:56,000
18 anomaly may have

607
00:34:01,029 --> 00:33:59,039
uh you know deja vu all over again with

608
00:34:02,230 --> 00:34:01,039
that whole but that whole story

609
00:34:04,710 --> 00:34:02,240
so

610
00:34:06,230 --> 00:34:04,720
that's only one part of as a as an old

611
00:34:07,990 --> 00:34:06,240
television program used to say there are

612
00:34:09,109 --> 00:34:08,000
eight million stories in the naked city

613
00:34:10,149 --> 00:34:09,119

and there's certainly eight million

614

00:34:11,990 --> 00:34:10,159

stories

615

00:34:13,589 --> 00:34:12,000

in terms of getting curiosity to where

616

00:34:15,349 --> 00:34:13,599

it is in today and

617

00:34:17,270 --> 00:34:15,359

and i think that people would

618

00:34:18,710 --> 00:34:17,280

would would be disappointed if i didn't

619

00:34:20,149 --> 00:34:18,720

point out that for all this wonderful

620

00:34:21,829 --> 00:34:20,159

congratulations and for all this

621

00:34:23,270 --> 00:34:21,839

wonderful feeling and for this

622

00:34:25,030 --> 00:34:23,280

celebration the fact is we're halfway

623

00:34:26,470 --> 00:34:25,040

through the mission we have not yet

624

00:34:27,829 --> 00:34:26,480

leveled that final level one

625

00:34:29,430 --> 00:34:27,839

requirements and

626

00:34:30,869 --> 00:34:29,440

but uh but i think the science panel

627

00:34:32,869 --> 00:34:30,879

will be up next and we'll talk about

628

00:34:44,550 --> 00:34:32,879

what we have accomplished and and and

629

00:34:49,589 --> 00:34:46,069

well thank you pete

630

00:34:52,230 --> 00:34:49,599

thank you matt allen and jessica

631

00:34:54,069 --> 00:34:52,240

uh in order to set up our discussion of

632

00:34:56,389 --> 00:34:54,079

some of the scientific achievements that

633

00:34:59,109 --> 00:34:56,399

we've seen thus far in the mission let's

634

00:35:12,710 --> 00:34:59,119

use some pictures to remind us of what's

635

00:35:16,470 --> 00:35:14,069

hello everybody

636

00:35:18,310 --> 00:35:16,480

good morning mr president

637

00:35:21,270 --> 00:35:18,320

i just want to call and say

638

00:35:23,589 --> 00:35:21,280

congratulations to the entire uh hard

639

00:35:25,349 --> 00:35:23,599

science laboratory team what you

640

00:35:27,109 --> 00:35:25,359

accomplished embodied the american

641

00:35:29,349 --> 00:35:27,119

spirit and your passion and your

642

00:35:31,910 --> 00:35:29,359

commitment is making a difference you

643

00:35:34,470 --> 00:35:31,920

guys have done an outstanding job you

644

00:35:37,190 --> 00:35:34,480

made us all proud curiosity is going to

645

00:35:38,710 --> 00:35:37,200

be telling us things that we did not

646

00:35:39,589 --> 00:35:38,720

know before and laying the groundwork

647

00:35:41,430 --> 00:35:39,599

for

648

00:35:42,870 --> 00:35:41,440

an even more audacious undertaking in

649

00:35:48,069 --> 00:35:42,880

the future as the human mission of the

650

00:35:52,470 --> 00:35:50,710

to recap here we have a set of go no-go

651
00:35:55,190 --> 00:35:52,480
criteria we want to make sure that the

652
00:35:56,310 --> 00:35:55,200
vehicle is healthy and safe

653
00:35:58,230 --> 00:35:56,320
i will

654
00:35:59,510 --> 00:35:58,240
give everybody a heads up about 15

655
00:36:06,870 --> 00:35:59,520
minutes in advance of when we're

656
00:36:11,990 --> 00:36:08,630
images are coming down

657
00:36:32,630 --> 00:36:12,000
and everything looks looks good really

658
00:36:37,670 --> 00:36:34,870
congratulations everybody it looks like

659
00:36:39,589 --> 00:36:37,680
we've got some nice new images to look

660
00:37:09,270 --> 00:36:39,599
at on the surface and

661
00:37:13,910 --> 00:37:11,270
please

662
00:37:16,470 --> 00:37:13,920
help me welcome the project scientist

663
00:37:19,190 --> 00:37:16,480

for the mars science laboratory

664

00:37:22,390 --> 00:37:19,200

the man who leads an amazing team of

665

00:37:33,829 --> 00:37:22,400

science across our planet ladies and

666

00:37:40,150 --> 00:37:35,829

well it's a real pleasure to be here on

667

00:37:42,230 --> 00:37:40,160

behalf of our 468 science team members

668

00:37:43,910 --> 00:37:42,240

uh that work on the curiosity mission

669

00:37:45,910 --> 00:37:43,920

and i'd like to start by thanking our

670

00:37:48,150 --> 00:37:45,920

colleagues in engineering that have made

671

00:37:49,510 --> 00:37:48,160

this all possible it really has been

672

00:37:51,589 --> 00:37:49,520

spectacular what you all have

673

00:37:54,310 --> 00:37:51,599

accomplished so thank you for that

674

00:37:56,870 --> 00:37:54,320

i'm joined today by my colleagues on the

675

00:37:58,710 --> 00:37:56,880

mission uh ken edgett who is the

676

00:38:02,950 --> 00:37:58,720

principal investigator of the mali

677

00:38:05,510 --> 00:38:02,960

instrument and a lifelong mars scientist

678

00:38:08,550 --> 00:38:05,520

and bethany ellman another colleague on

679

00:38:09,910 --> 00:38:08,560

the mission who works as one of our

680

00:38:11,270 --> 00:38:09,920

tactical

681

00:38:13,750 --> 00:38:11,280

uh

682

00:38:16,230 --> 00:38:13,760

leads called a science operation working

683

00:38:17,109 --> 00:38:16,240

group chair that that commands the rover

684

00:38:19,829 --> 00:38:17,119

and

685

00:38:21,829 --> 00:38:19,839

adjudicates between all the different

686

00:38:23,750 --> 00:38:21,839

uh people that would like to do science

687

00:38:26,069 --> 00:38:23,760

each day and coming up with a final list

688

00:38:28,790 --> 00:38:26,079

of what needs to be done and ashwin

689

00:38:30,870 --> 00:38:28,800

vasavada who is an atmospheric scientist

690

00:38:32,390 --> 00:38:30,880

and the deputy project scientist along

691

00:38:35,109 --> 00:38:32,400

with joy crisp

692

00:38:37,750 --> 00:38:35,119

and ashwin does tactical work as well as

693

00:38:39,670 --> 00:38:37,760

strategic work and i think we widely

694

00:38:40,790 --> 00:38:39,680

appreciate him for pretty much running

695

00:38:41,589 --> 00:38:40,800

the mission

696

00:38:43,910 --> 00:38:41,599

and

697

00:38:46,870 --> 00:38:43,920

he does a terrific job i want to take

698

00:38:48,950 --> 00:38:46,880

you back to to the drill hole uh that

699

00:38:49,910 --> 00:38:48,960

that really has made history for this

700

00:38:53,430 --> 00:38:49,920

mission

701
00:38:55,829 --> 00:38:53,440
and it shared as a major uh engineering

702
00:38:57,510 --> 00:38:55,839
accomplishment it wasn't seven minutes

703
00:38:59,349 --> 00:38:57,520
it took seven months

704
00:39:01,829 --> 00:38:59,359
and you know this was something that the

705
00:39:03,829 --> 00:39:01,839
team worked incredibly hard at and we

706
00:39:07,030 --> 00:39:03,839
approached this prospect with great

707
00:39:09,430 --> 00:39:07,040
anticipation because before we landed

708
00:39:11,109 --> 00:39:09,440
the science team made a map

709
00:39:12,710 --> 00:39:11,119
and with that map

710
00:39:14,150 --> 00:39:12,720
when we landed we decided to do

711
00:39:16,630 --> 00:39:14,160
something that completely baffled the

712
00:39:18,310 --> 00:39:16,640
media which was to drive in the opposite

713
00:39:19,829 --> 00:39:18,320

direction that we had told everybody we

714

00:39:21,109 --> 00:39:19,839

were going to be driving in we're

715

00:39:22,630 --> 00:39:21,119

supposed to be driving towards this

716

00:39:25,270 --> 00:39:22,640

mountain and now the science team is

717

00:39:27,589 --> 00:39:25,280

headed off in the opposite direction we

718

00:39:29,349 --> 00:39:27,599

had a few people to explain that to and

719

00:39:31,750 --> 00:39:29,359

and rationalize

720

00:39:34,230 --> 00:39:31,760

uh but the reason for that was is that

721

00:39:36,470 --> 00:39:34,240

that the team had done their homework

722

00:39:38,069 --> 00:39:36,480

and with all the incredible work that

723

00:39:41,349 --> 00:39:38,079

came down from mars reconnaissance

724

00:39:44,470 --> 00:39:41,359

orbiter uh the high-rise uh camera the

725

00:39:46,470 --> 00:39:44,480

chrison uh hyperspectral camera we were

726

00:39:48,870 --> 00:39:46,480

able to come up with a very highly

727

00:39:51,190 --> 00:39:48,880

evolved understanding of what our

728

00:39:53,589 --> 00:39:51,200

options were so that when we landed we

729

00:39:55,910 --> 00:39:53,599

decided to execute one that took us on

730

00:39:57,589 --> 00:39:55,920

this path eventually down into a place

731

00:39:58,630 --> 00:39:57,599

called yellowknife bay where we drilled

732

00:40:00,710 --> 00:39:58,640

this hole

733

00:40:02,550 --> 00:40:00,720

and when we drilled into it we realized

734

00:40:04,470 --> 00:40:02,560

the scent was getting warmer and warmer

735

00:40:06,630 --> 00:40:04,480

and then as we got down in there

736

00:40:08,790 --> 00:40:06,640

we drilled it we looked at it and mars

737

00:40:10,470 --> 00:40:08,800

changed from red to gray and that told

738

00:40:11,670 --> 00:40:10,480

us that the iron was reduced which is

739

00:40:13,670 --> 00:40:11,680

something that's very important for

740

00:40:15,990 --> 00:40:13,680

microbial metabolism

741

00:40:18,069 --> 00:40:16,000

and basically what we got out of that

742

00:40:20,790 --> 00:40:18,079

was an understanding of a habitable

743

00:40:23,190 --> 00:40:20,800

environment which is not just yet again

744

00:40:25,589 --> 00:40:23,200

another discovery of water but

745

00:40:27,270 --> 00:40:25,599

characterizing that water and the rocks

746

00:40:30,630 --> 00:40:27,280

and the minerals that were there

747

00:40:32,310 --> 00:40:30,640

to tell us that if simple microorganisms

748

00:40:34,630 --> 00:40:32,320

so simple that they don't need sunlight

749

00:40:35,910 --> 00:40:34,640

they need only chemical energy they use

750

00:40:37,589 --> 00:40:35,920

rocks and minerals sort of like

751

00:40:40,630 --> 00:40:37,599

batteries and there's a transfer of

752

00:40:41,829 --> 00:40:40,640

electrons as the microorganism interacts

753

00:40:44,790 --> 00:40:41,839

with these

754

00:40:46,390 --> 00:40:44,800

chemical substances that are there and

755

00:40:48,790 --> 00:40:46,400

what we were able to do with the payload

756

00:40:51,030 --> 00:40:48,800

this was a truly integrated set of

757

00:40:53,030 --> 00:40:51,040

observations every instrument was

758

00:40:55,270 --> 00:40:53,040

involved in this the rems instrument

759

00:40:57,030 --> 00:40:55,280

which is our atmospheric experiment

760

00:40:59,190 --> 00:40:57,040

actually has a ground temperature sensor

761

00:41:01,109 --> 00:40:59,200

so that when we crossed over this

762

00:41:03,670 --> 00:41:01,119

boundary that you had seen in the with

763

00:41:05,349 --> 00:41:03,680

themis data from orbiter from odyssey

764

00:41:07,910 --> 00:41:05,359

that predicted we would cross over into

765

00:41:09,750 --> 00:41:07,920

high thermal inertia terrain when we

766

00:41:11,990 --> 00:41:09,760

crossed over that boundary within one

767

00:41:13,829 --> 00:41:12,000

saw the ground temperature sensor on

768

00:41:16,870 --> 00:41:13,839

rems told us we were in the right

769

00:41:17,670 --> 00:41:16,880

terrain the remote sensing package the

770

00:41:20,150 --> 00:41:17,680

the

771

00:41:21,589 --> 00:41:20,160

chemcam instrument worked perfectly to

772

00:41:23,349 --> 00:41:21,599

tell us that suddenly there were

773

00:41:24,309 --> 00:41:23,359

sulfates there where we had seen none

774

00:41:25,990 --> 00:41:24,319

before

775

00:41:27,510 --> 00:41:26,000

and then after that as we went down even

776

00:41:30,230 --> 00:41:27,520

the rat instrument which measures the

777

00:41:31,990 --> 00:41:30,240

background radiation for for astronauts

778

00:41:34,630 --> 00:41:32,000

to do future exploration it made a

779

00:41:36,630 --> 00:41:34,640

measurement it all added up to

780

00:41:38,870 --> 00:41:36,640

understanding this environment as being

781

00:41:41,349 --> 00:41:38,880

chemically one that was favorable for

782

00:41:42,790 --> 00:41:41,359

life not in a in a harsh way but

783

00:41:44,870 --> 00:41:42,800

actually quite a benign environment

784

00:41:47,190 --> 00:41:44,880

that's very much like earth so we have

785

00:41:49,270 --> 00:41:47,200

this new understanding now that's what

786

00:41:51,190 --> 00:41:49,280

we found and i want to turn it over my

787

00:41:53,190 --> 00:41:51,200

colleague ken now who can take you back

788

00:41:55,589 --> 00:41:53,200

a little bit to talk about his

789

00:41:57,750 --> 00:41:55,599

experience and early observations of

790

00:41:59,670 --> 00:41:57,760

gail and what it's like to be the

791

00:42:03,109 --> 00:41:59,680

principal investigator on the mission

792

00:42:04,790 --> 00:42:03,119

that's a whole lot of stuff

793

00:42:06,710 --> 00:42:04,800

first of all what it's like to be a

794

00:42:08,710 --> 00:42:06,720

principal investigator i'm just one of

795

00:42:11,430 --> 00:42:08,720

the team there's over 400 people on this

796

00:42:13,829 --> 00:42:11,440

team each one of us represents about 100

797

00:42:15,510 --> 00:42:13,839

plus of them just by sitting here we

798

00:42:17,190 --> 00:42:15,520

love them all and we work with them very

799

00:42:18,470 --> 00:42:17,200

carefully and closely

800

00:42:20,870 --> 00:42:18,480

uh

801

00:42:24,470 --> 00:42:20,880

i we none of us do this by ourselves

802

00:42:26,630 --> 00:42:24,480

this is a group effort and i am always

803

00:42:28,550 --> 00:42:26,640

always learning new things from the

804

00:42:30,230 --> 00:42:28,560

people i work with the people here that

805

00:42:31,990 --> 00:42:30,240

i've worked with it's a very

806

00:42:34,550 --> 00:42:32,000

overwhelming experience

807

00:42:37,190 --> 00:42:34,560

but what we have found is so stunning

808

00:42:38,710 --> 00:42:37,200

because if you asked me a year ago

809

00:42:40,390 --> 00:42:38,720

what are you going to find in the first

810

00:42:42,710 --> 00:42:40,400

year i wouldn't have ever said we're

811

00:42:45,430 --> 00:42:42,720

going to find what we went looking for

812

00:42:47,270 --> 00:42:45,440

we don't know mars that well

813

00:42:50,309 --> 00:42:47,280

we still don't know mars that well so

814

00:42:53,270 --> 00:42:50,319

i'm really still very surprised

815

00:42:56,069 --> 00:42:53,280

long ago if you think of a martian day

816

00:42:58,710 --> 00:42:56,079

as like a 24 hour clock and right now

817

00:43:00,790 --> 00:42:58,720

this moment is just some teeny fraction

818

00:43:01,670 --> 00:43:00,800

micro second before midnight of the next

819

00:43:03,990 --> 00:43:01,680

day

820

00:43:06,710 --> 00:43:04,000

the rocks we're looking at and exploring

821

00:43:10,069 --> 00:43:06,720

in gale are back somewhere around in the

822

00:43:11,990 --> 00:43:10,079

3 a.m to 6 a.m time frame of mars

823

00:43:13,990 --> 00:43:12,000

history so it's a very long time ago

824

00:43:16,630 --> 00:43:14,000

mars was a different place

825

00:43:18,790 --> 00:43:16,640

at that time there were larger craters

826

00:43:20,790 --> 00:43:18,800

forming on mars more frequently than now

827

00:43:23,270 --> 00:43:20,800

and there were volcanoes erupting and

828

00:43:26,230 --> 00:43:23,280

all of those things produce sediment and

829

00:43:28,230 --> 00:43:26,240

the atmosphere was thicker and wind

830

00:43:30,309 --> 00:43:28,240

transports sediment and then we now

831

00:43:32,150 --> 00:43:30,319

think and know from all the missions

832

00:43:33,910 --> 00:43:32,160

over the last 15 years that there was

833

00:43:36,230 --> 00:43:33,920

water there's still water it's frozen

834

00:43:38,550 --> 00:43:36,240

now but there was liquid water the water

835

00:43:40,069 --> 00:43:38,560

not only transports sediment it also

836

00:43:42,150 --> 00:43:40,079

causes rock to break down and

837

00:43:43,430 --> 00:43:42,160

disintegrate into other types of

838

00:43:45,750 --> 00:43:43,440

minerals and chemistries which

839

00:43:49,270 --> 00:43:45,760

precipitate out as other minerals and

840

00:43:52,309 --> 00:43:49,280

we're finding those minerals in gale

841

00:43:54,150 --> 00:43:52,319

gale's a hole in the ground sediments

842

00:43:57,109 --> 00:43:54,160

from this early time with all this stuff

843

00:43:58,790 --> 00:43:57,119

going on piled up in gale um just like

844

00:44:00,790 --> 00:43:58,800

on many other craters on mars there are

845

00:44:02,550 --> 00:44:00,800

craters the size of gale and bigger that

846

00:44:04,230 --> 00:44:02,560

are still buried and we don't even know

847

00:44:05,349 --> 00:44:04,240

the crater exists

848

00:44:08,309 --> 00:44:05,359

gail though

849

00:44:10,470 --> 00:44:08,319

by some magical erosional process has

850

00:44:12,470 --> 00:44:10,480

somewhat exhumed itself and left behind

851
00:44:15,190 --> 00:44:12,480
this remnant this mountain that's three

852
00:44:18,230 --> 00:44:15,200
miles or five kilometers high of layered

853
00:44:19,109 --> 00:44:18,240
sedimentary rock we went there thinking

854
00:44:21,430 --> 00:44:19,119
that

855
00:44:23,030 --> 00:44:21,440
every layer is a page in a history book

856
00:44:25,109 --> 00:44:23,040
and we can

857
00:44:27,510 --> 00:44:25,119
go there and see not only are there

858
00:44:28,950 --> 00:44:27,520
habitable environments recorded in there

859
00:44:31,430 --> 00:44:28,960
but is

860
00:44:33,670 --> 00:44:31,440
how do the environments change over time

861
00:44:35,990 --> 00:44:33,680
as you go up the mountain you will see

862
00:44:36,950 --> 00:44:36,000
the the time getting closer and closer

863
00:44:38,870 --> 00:44:36,960

to now

864

00:44:41,030 --> 00:44:38,880

still a long time ago but it will get

865

00:44:42,390 --> 00:44:41,040

younger and younger so

866

00:44:46,470 --> 00:44:42,400

it's stunning i don't remember what else

867

00:44:51,270 --> 00:44:48,309

we could all go on for a long time yeah

868

00:44:55,349 --> 00:44:51,280

so you you had been looking at gail for

869

00:44:57,270 --> 00:44:55,359

10 years 14 14. yeah and then we wound

870

00:44:59,510 --> 00:44:57,280

up there yeah what were you thinking i

871

00:45:02,069 --> 00:44:59,520

had the incredible privilege 14 years

872

00:45:04,550 --> 00:45:02,079

ago of being able to select targets for

873

00:45:07,030 --> 00:45:04,560

the camera on mars global surveyor

874

00:45:09,270 --> 00:45:07,040

and gale was one of the places that we

875

00:45:10,710 --> 00:45:09,280

stumbled on as holy cow look at this

876

00:45:13,589 --> 00:45:10,720

there are these layered sediments and

877

00:45:16,550 --> 00:45:13,599

then the story i just told evolved to

878

00:45:19,430 --> 00:45:16,560

actually land in one of the pictures you

879

00:45:21,670 --> 00:45:19,440

helped take 14 years ago and then the

880

00:45:23,829 --> 00:45:21,680

camera that you're now responsible for

881

00:45:26,069 --> 00:45:23,839

gets down and right up to the rocks like

882

00:45:27,829 --> 00:45:26,079

that and sees those rocks up that close

883

00:45:31,510 --> 00:45:27,839

after being three four hundred

884

00:45:34,150 --> 00:45:31,520

kilometers up it's just good

885

00:45:35,109 --> 00:45:34,160

the 21st century people

886

00:45:36,390 --> 00:45:35,119

awesome

887

00:45:38,309 --> 00:45:36,400

so bethany

888

00:45:39,550 --> 00:45:38,319

tell us about what it's like in the day

889

00:45:42,630 --> 00:45:39,560

of a rover

890

00:45:44,309 --> 00:45:42,640

468 people all want to go left

891

00:45:46,150 --> 00:45:44,319

some want to go right

892

00:45:47,910 --> 00:45:46,160

how do you how do you wade through this

893

00:45:49,430 --> 00:45:47,920

process what kind of decisions and

894

00:45:51,589 --> 00:45:49,440

what's it like to operate the most

895

00:45:53,829 --> 00:45:51,599

complex vehicle that's ever landed on

896

00:45:55,589 --> 00:45:53,839

another planet yeah well uh well first

897

00:45:57,510 --> 00:45:55,599

of all it's a lot of fun to operate the

898

00:45:58,790 --> 00:45:57,520

most complex vehicle vehicle that's ever

899

00:46:01,589 --> 00:45:58,800

landed on another planet so it's

900

00:46:04,390 --> 00:46:01,599

enormous privilege to you know be

901
00:46:05,430 --> 00:46:04,400
a part of the team but also to be sort

902
00:46:07,190 --> 00:46:05,440
of in

903
00:46:08,790 --> 00:46:07,200
taking on this role in the day-to-day

904
00:46:10,630 --> 00:46:08,800
sense that really is kind of the nexus

905
00:46:12,230 --> 00:46:10,640
between science and engineering and

906
00:46:14,069 --> 00:46:12,240
getting these to work together so

907
00:46:16,710 --> 00:46:14,079
working with the engineers to implement

908
00:46:20,790 --> 00:46:16,720
the science desires in the best possible

909
00:46:22,950 --> 00:46:20,800
way uh utilizing the energy the the data

910
00:46:25,270 --> 00:46:22,960
downlink capacity and all of those other

911
00:46:27,190 --> 00:46:25,280
things that limit what we can do uh any

912
00:46:28,390 --> 00:46:27,200
given day how do we get the best science

913
00:46:30,150 --> 00:46:28,400

done

914

00:46:31,510 --> 00:46:30,160

but uh what's really interesting about

915

00:46:33,030 --> 00:46:31,520

this is before we can get to the

916

00:46:34,790 --> 00:46:33,040

question in the process of implementing

917

00:46:36,309 --> 00:46:34,800

the plan for how to get the best science

918

00:46:38,790 --> 00:46:36,319

done we kind of have to come to

919

00:46:40,829 --> 00:46:38,800

agreement as a team as to well what is

920

00:46:43,750 --> 00:46:40,839

the science that we should be doing

921

00:46:45,910 --> 00:46:43,760

anyway uh so part of this this whole

922

00:46:48,630 --> 00:46:45,920

process of operation is getting you know

923

00:46:50,150 --> 00:46:48,640

400 and something science folks marching

924

00:46:51,430 --> 00:46:50,160

in the same direction or at least the

925

00:46:53,190 --> 00:46:51,440

same general

926
00:46:56,790 --> 00:46:53,200
direction and uh you know that's a

927
00:46:59,030 --> 00:46:56,800
process that that that folks lead both

928
00:47:00,950 --> 00:46:59,040
strategically and tactically so i

929
00:47:03,990 --> 00:47:00,960
remember kind of along the i don't know

930
00:47:06,390 --> 00:47:04,000
maybe it's around the 100th saw on mars

931
00:47:08,710 --> 00:47:06,400
or so maybe a little bit before that

932
00:47:10,790 --> 00:47:08,720
there was a big push with with john and

933
00:47:12,790 --> 00:47:10,800
ashwin and enjoy the members of the

934
00:47:14,790 --> 00:47:12,800
project science group it was like okay

935
00:47:17,349 --> 00:47:14,800
we have this amazing stratigraphy these

936
00:47:18,870 --> 00:47:17,359
layers of rocks before us what is our

937
00:47:20,309 --> 00:47:18,880
strategy like what do we want to

938
00:47:22,069 --> 00:47:20,319

accomplish we all agree that this is

939

00:47:24,550 --> 00:47:22,079

like cool

940

00:47:26,630 --> 00:47:24,560

but what is it we want to do well and

941

00:47:28,790 --> 00:47:26,640

and it was even more profound than that

942

00:47:31,109 --> 00:47:28,800

some people were saying these are lake

943

00:47:33,270 --> 00:47:31,119

sediments other people were saying these

944

00:47:34,870 --> 00:47:33,280

are fluvially transported you know down

945

00:47:36,950 --> 00:47:34,880

from the rim of the crater deposited

946

00:47:39,750 --> 00:47:36,960

chaotically or maybe it's volcanic

947

00:47:41,990 --> 00:47:39,760

sediments or maybe it's air fall

948

00:47:44,309 --> 00:47:42,000

sort of an ash deposit

949

00:47:46,470 --> 00:47:44,319

okay so each each of us scientists comes

950

00:47:48,710 --> 00:47:46,480

in with our our set of hypotheses about

951
00:47:51,109 --> 00:47:48,720
how mars works how these rock units

952
00:47:52,710 --> 00:47:51,119
relate to how mars works so then it's a

953
00:47:55,109 --> 00:47:52,720
process of figuring out okay well how do

954
00:47:56,309 --> 00:47:55,119
we sit down and test these ideas and

955
00:47:57,589 --> 00:47:56,319
that's really one of the amazing things

956
00:47:59,910 --> 00:47:57,599
about working on the science team is

957
00:48:01,670 --> 00:47:59,920
that even if we disagree completely

958
00:48:03,750 --> 00:48:01,680
about how a particular rock unit is

959
00:48:06,150 --> 00:48:03,760
formed we can still come to a consensus

960
00:48:10,150 --> 00:48:06,160
on okay well how is it we test out how

961
00:48:12,230 --> 00:48:10,160
these particular rock units form and if

962
00:48:13,670 --> 00:48:12,240
we sit down and we we have it out you

963
00:48:15,349 --> 00:48:13,680

know during the beginning of the mission

964

00:48:16,870 --> 00:48:15,359

it was every day we'd have science

965

00:48:18,309 --> 00:48:16,880

discussions about what we're thinking

966

00:48:20,069 --> 00:48:18,319

about how we're interpreting this

967

00:48:21,430 --> 00:48:20,079

different unit but what was interesting

968

00:48:23,030 --> 00:48:21,440

is that even if we disagreed

969

00:48:25,349 --> 00:48:23,040

scientifically about how something came

970

00:48:27,510 --> 00:48:25,359

to be we could agree that that place on

971

00:48:29,670 --> 00:48:27,520

mars is important and that is the place

972

00:48:31,270 --> 00:48:29,680

that we need to investigate and so it

973

00:48:33,030 --> 00:48:31,280

all comes down came down from these

974

00:48:34,950 --> 00:48:33,040

strategic decisions for where we need to

975

00:48:37,430 --> 00:48:34,960

go and then day to day sticking on the

976
00:48:39,589 --> 00:48:37,440
plan keeping in mind what is important

977
00:48:41,750 --> 00:48:39,599
to to to reach these high level

978
00:48:43,829 --> 00:48:41,760
objectives to to explore this particular

979
00:48:45,510 --> 00:48:43,839
rock unit then this one then this one

980
00:48:48,790 --> 00:48:45,520
retaining the sequence events in your

981
00:48:50,470 --> 00:48:48,800
head as you plan each day on mars

982
00:48:52,549 --> 00:48:50,480
is there one moment that sticks out in

983
00:48:53,430 --> 00:48:52,559
your mind a science discovery that

984
00:48:56,870 --> 00:48:53,440
you'll

985
00:48:59,349 --> 00:48:56,880
sort of my

986
00:49:01,990 --> 00:48:59,359
my uh my absolute favorite my favorite

987
00:49:05,109 --> 00:49:02,000
set of pictures that that came down uh

988
00:49:06,549 --> 00:49:05,119

from the rover was when uh so we had we

989

00:49:09,349 --> 00:49:06,559

had been working our way down the

990

00:49:11,190 --> 00:49:09,359

stratigraphy into the yellowknife bay

991

00:49:13,750 --> 00:49:11,200

sediments that you mentioned where where

992

00:49:15,829 --> 00:49:13,760

we saw the picture of the drill hole

993

00:49:17,670 --> 00:49:15,839

and for me before the drill what was

994

00:49:19,109 --> 00:49:17,680

most amazing is it was after one of our

995

00:49:21,990 --> 00:49:19,119

drives heading heading down the

996

00:49:24,950 --> 00:49:22,000

depression into yellowknife bay

997

00:49:27,430 --> 00:49:24,960

when the navcam images uh came down that

998

00:49:29,109 --> 00:49:27,440

day onto the computers onto the the

999

00:49:30,870 --> 00:49:29,119

software system that all of us used to

1000

00:49:32,630 --> 00:49:30,880

operate the rovers those pictures had

1001

00:49:34,069 --> 00:49:32,640

these little funny nodules or

1002

00:49:36,069 --> 00:49:34,079

concretions and then you could see these

1003

00:49:38,069 --> 00:49:36,079

light veins heading heading through the

1004

00:49:39,829 --> 00:49:38,079

rock and it was like oh this just got

1005

00:49:41,670 --> 00:49:39,839

real interesting

1006

00:49:43,510 --> 00:49:41,680

in terms of the habitability story in

1007

00:49:44,950 --> 00:49:43,520

terms of the water on mars story so that

1008

00:49:46,470 --> 00:49:44,960

definitely was one of my favorite days

1009

00:49:47,349 --> 00:49:46,480

and favorite images

1010

00:49:50,790 --> 00:49:47,359

great

1011

00:49:52,309 --> 00:49:50,800

so so speaking of of water ashwin as

1012

00:49:54,150 --> 00:49:52,319

atmospheric scientists you've got all

1013

00:49:56,150 --> 00:49:54,160

these geologists and geochemists that

1014

00:49:57,270 --> 00:49:56,160

are you know always wanting to drill and

1015

00:49:58,870 --> 00:49:57,280

sample and do all that but the

1016

00:50:00,150 --> 00:49:58,880

atmosphere is a really important part of

1017

00:50:02,549 --> 00:50:00,160

it we're trying to get at the very

1018

00:50:04,630 --> 00:50:02,559

ancient atmosphere

1019

00:50:06,230 --> 00:50:04,640

we had the discovery of a conglomerate

1020

00:50:08,069 --> 00:50:06,240

we see this evidence for flowing water

1021

00:50:09,589 --> 00:50:08,079

and some people might say well we've

1022

00:50:11,670 --> 00:50:09,599

found evidence for flowing water from

1023

00:50:14,069 --> 00:50:11,680

the surface of mars but it's important

1024

00:50:16,069 --> 00:50:14,079

to confirm it from the surface what goes

1025

00:50:18,069 --> 00:50:16,079

through your mind now wondering because

1026

00:50:19,670 --> 00:50:18,079

it's not like we see some giant gusher

1027

00:50:22,230 --> 00:50:19,680

where it might have catastrophically

1028

00:50:23,510 --> 00:50:22,240

flowed out from mars this seems like the

1029

00:50:25,349 --> 00:50:23,520

climate might have been different then

1030

00:50:26,710 --> 00:50:25,359

what what were you thinking when you saw

1031

00:50:28,950 --> 00:50:26,720

that image

1032

00:50:31,030 --> 00:50:28,960

well as ken said you know mars is an

1033

00:50:32,549 --> 00:50:31,040

extremely different planet today than it

1034

00:50:34,630 --> 00:50:32,559

was in the past that's one of the

1035

00:50:36,470 --> 00:50:34,640

reasons we we go there so often we have

1036

00:50:37,270 --> 00:50:36,480

this idea that mars was a warmer wetter

1037

00:50:38,710 --> 00:50:37,280

place

1038

00:50:40,230 --> 00:50:38,720

may have been more friendly to life and

1039

00:50:42,230 --> 00:50:40,240

may have had an extremely different

1040

00:50:43,910 --> 00:50:42,240

environment back then

1041

00:50:45,589 --> 00:50:43,920

one that was able to support liquid

1042

00:50:46,630 --> 00:50:45,599

water flowing on the surface of course

1043

00:50:48,630 --> 00:50:46,640

we'd seen

1044

00:50:50,470 --> 00:50:48,640

pictures for decades of mars with these

1045

00:50:51,750 --> 00:50:50,480

catastrophic flood channels and river

1046

00:50:54,470 --> 00:50:51,760

systems

1047

00:50:56,069 --> 00:50:54,480

but never had we seen uh you know firm

1048

00:50:57,430 --> 00:50:56,079

evidence of it up close with our own

1049

00:51:01,109 --> 00:50:57,440

eyes and

1050

00:51:03,829 --> 00:51:01,119

about a year and a half ago i was out

1051
00:51:05,510 --> 00:51:03,839
in back of jpl where's the arroyo and

1052
00:51:07,589 --> 00:51:05,520
filming an outreach video about why we

1053
00:51:09,750 --> 00:51:07,599
selected gale as a landing site and

1054
00:51:11,589 --> 00:51:09,760
walking around back there and uh you

1055
00:51:13,109 --> 00:51:11,599
know it was springtime and water was

1056
00:51:15,030 --> 00:51:13,119
coming down the san gabriel mountains

1057
00:51:17,030 --> 00:51:15,040
and forming a little stream through the

1058
00:51:18,790 --> 00:51:17,040
arroyo and carrying debris down from the

1059
00:51:19,990 --> 00:51:18,800
mountains and the stream was full of

1060
00:51:21,430 --> 00:51:20,000
little pebbles

1061
00:51:23,510 --> 00:51:21,440
you know rounded as they made their way

1062
00:51:25,270 --> 00:51:23,520
down the mountains and sand with them

1063
00:51:26,950 --> 00:51:25,280

and we're just sort of you know looking

1064

00:51:28,870 --> 00:51:26,960

around and i told the cameraman as we're

1065

00:51:30,309 --> 00:51:28,880

filming this video if we ever found

1066

00:51:31,349 --> 00:51:30,319

something like this on mars it would be

1067

00:51:33,510 --> 00:51:31,359

a home run

1068

00:51:34,790 --> 00:51:33,520

and and like ken you know i think all of

1069

00:51:36,470 --> 00:51:34,800

us were

1070

00:51:38,549 --> 00:51:36,480

we'd say those things but in our heart

1071

00:51:40,390 --> 00:51:38,559

of hearts you know we we knew it was it

1072

00:51:41,910 --> 00:51:40,400

was a long shot you know it wasn't like

1073

00:51:44,390 --> 00:51:41,920

we took it for granted

1074

00:51:46,150 --> 00:51:44,400

uh and and then you fast forward to

1075

00:51:48,230 --> 00:51:46,160

landing a year ago and

1076

00:51:50,069 --> 00:51:48,240

um you know as as the rover's landing

1077

00:51:52,390 --> 00:51:50,079

it's it's rocket engines are scouring

1078

00:51:55,190 --> 00:51:52,400

away the gravel and the next morning you

1079

00:51:57,829 --> 00:51:55,200

know we we get these pictures from mars

1080

00:51:58,870 --> 00:51:57,839

and and we look in the in the the scour

1081

00:52:00,950 --> 00:51:58,880

mark and

1082

00:52:03,910 --> 00:52:00,960

what do you know it's bedrock a

1083

00:52:06,069 --> 00:52:03,920

conglomerate a rock made up of rounded

1084

00:52:08,309 --> 00:52:06,079

pebbles and sand cemented together you

1085

00:52:10,150 --> 00:52:08,319

know even before curiosity landed she

1086

00:52:12,549 --> 00:52:10,160

had already hit this home run for us and

1087

00:52:14,790 --> 00:52:12,559

and revealed this ancient mars to us

1088

00:52:15,910 --> 00:52:14,800

that we were hoping to find so we drove

1089

00:52:17,829 --> 00:52:15,920

literally

1090

00:52:19,030 --> 00:52:17,839

through a stream bed on mars that flowed

1091

00:52:21,270 --> 00:52:19,040

ankle deep

1092

00:52:23,109 --> 00:52:21,280

you know a few billion years ago that's

1093

00:52:25,270 --> 00:52:23,119

just i'm getting goosebumps just telling

1094

00:52:27,430 --> 00:52:25,280

you about it

1095

00:52:29,109 --> 00:52:27,440

so for me you know my interest is in the

1096

00:52:31,990 --> 00:52:29,119

atmosphere but really of the past

1097

00:52:34,230 --> 00:52:32,000

climate of mars and we knew that even if

1098

00:52:36,870 --> 00:52:34,240

we never found life with this mission we

1099

00:52:38,790 --> 00:52:36,880

would have this incredible uh secondary

1100

00:52:41,510 --> 00:52:38,800

ability with this rover to explore a

1101
00:52:43,109 --> 00:52:41,520
beautiful site that can help find and

1102
00:52:45,109 --> 00:52:43,119
that would tell us about this ancient

1103
00:52:46,230 --> 00:52:45,119
environment of mars that that's that's

1104
00:52:47,750 --> 00:52:46,240
just uh you know we're just

1105
00:52:49,670 --> 00:52:47,760
archaeologists sort of trying to piece

1106
00:52:51,270 --> 00:52:49,680
that together with this rover

1107
00:52:53,990 --> 00:52:51,280
so how would that how is this going to

1108
00:52:56,390 --> 00:52:54,000
feed into uh the maven mission

1109
00:52:58,150 --> 00:52:56,400
yeah that what's exciting is that um

1110
00:52:59,430 --> 00:52:58,160
we're here on the ground uh sort of

1111
00:53:01,030 --> 00:52:59,440
getting this ground truth of what the

1112
00:53:03,030 --> 00:53:01,040
atmosphere and climate would have been

1113
00:53:05,349 --> 00:53:03,040

like billions of years ago

1114

00:53:06,870 --> 00:53:05,359
and it fits into this general theory

1115

00:53:08,790 --> 00:53:06,880
that we have about mars atmosphere that

1116

00:53:11,349 --> 00:53:08,800
it's lost over time and one of the

1117

00:53:13,270 --> 00:53:11,359
primary reasons we think it was lost is

1118

00:53:15,349 --> 00:53:13,280
mars magnetic field went away and

1119

00:53:16,870 --> 00:53:15,359
exposed made mars atmosphere vulnerable

1120

00:53:18,470 --> 00:53:16,880
it's being stripped away by the solar

1121

00:53:20,630 --> 00:53:18,480
wind by the sun

1122

00:53:22,390 --> 00:53:20,640
and so we're sort of seeing that we're

1123

00:53:24,309 --> 00:53:22,400
painting together the story from the

1124

00:53:26,790 --> 00:53:24,319
ground up of how that may have happened

1125

00:53:29,270 --> 00:53:26,800
maven an orbiter will arrive at mars i

1126

00:53:31,270 --> 00:53:29,280

think next year and begin studying the

1127

00:53:33,750 --> 00:53:31,280

atmosphere from the top down watching in

1128

00:53:35,829 --> 00:53:33,760

real time as the sun continues to road

1129

00:53:38,710 --> 00:53:35,839

away the atmosphere and together the two

1130

00:53:40,150 --> 00:53:38,720

missions will help understand early mars

1131

00:53:42,870 --> 00:53:40,160

great thanks guys

1132

00:53:45,030 --> 00:53:42,880

so you know that gives us a view of how

1133

00:53:47,270 --> 00:53:45,040

a curiosity's mission will pass on to

1134

00:53:49,829 --> 00:53:47,280

the to the next mission and i'll just

1135

00:53:52,309 --> 00:53:49,839

finish up with a few words about uh what

1136

00:53:55,349 --> 00:53:52,319

curiosity we'll do now i think the part

1137

00:53:57,829 --> 00:53:55,359

of this as as you've heard all of us

1138

00:53:59,270 --> 00:53:57,839

we really we have these hopes you don't

1139

00:54:01,430 --> 00:53:59,280

know that it's you're really going to

1140

00:54:02,870 --> 00:54:01,440

find this stuff and i think the most

1141

00:54:04,790 --> 00:54:02,880

extraordinary thing

1142

00:54:07,510 --> 00:54:04,800

really is that we found it all so

1143

00:54:08,870 --> 00:54:07,520

quickly and that decision to drive 500

1144

00:54:11,589 --> 00:54:08,880

meters in the opposite direction

1145

00:54:13,670 --> 00:54:11,599

obviously paid off uh very well

1146

00:54:15,910 --> 00:54:13,680

and we haven't even gotten towards our

1147

00:54:17,990 --> 00:54:15,920

prime goal yet we selected gail out of

1148

00:54:20,309 --> 00:54:18,000

the four finalists for one simple reason

1149

00:54:23,030 --> 00:54:20,319

it was a unanimous decision to pick the

1150

00:54:25,270 --> 00:54:23,040

gail site because it's so diverse so by

1151
00:54:27,510 --> 00:54:25,280
driving now to mount sharp we will

1152
00:54:29,430 --> 00:54:27,520
return to our initial objective

1153
00:54:32,069 --> 00:54:29,440
which is to explore these foothills that

1154
00:54:33,829 --> 00:54:32,079
you can see here that are the size think

1155
00:54:36,309 --> 00:54:33,839
about driving around the lab here you've

1156
00:54:38,950 --> 00:54:36,319
got buildings that are sort of one to

1157
00:54:40,390 --> 00:54:38,960
three to five stories tall with narrow

1158
00:54:42,230 --> 00:54:40,400
corridors between them that's this

1159
00:54:44,230 --> 00:54:42,240
terrain that you're looking at there

1160
00:54:45,910 --> 00:54:44,240
that'll that'll be what it's like as we

1161
00:54:48,309 --> 00:54:45,920
get into that terrain it's going to be

1162
00:54:50,230 --> 00:54:48,319
we think visually quite beautiful

1163
00:54:51,750 --> 00:54:50,240

but those layers that you see there we

1164

00:54:53,349 --> 00:54:51,760

know from orbit from the chrim data

1165

00:54:55,349 --> 00:54:53,359

that they have clays we know that

1166

00:54:57,190 --> 00:54:55,359

there's hematite we know that there's

1167

00:54:59,750 --> 00:54:57,200

sulfate so we hope to be able to sample

1168

00:55:01,670 --> 00:54:59,760

a number of what could be

1169

00:55:03,430 --> 00:55:01,680

a different habitable environments and

1170

00:55:05,349 --> 00:55:03,440

maybe revisit some old friends that

1171

00:55:06,390 --> 00:55:05,359

we've seen from previous missions things

1172

00:55:09,109 --> 00:55:06,400

like that

1173

00:55:10,870 --> 00:55:09,119

so we're all really excited uh to carry

1174

00:55:13,109 --> 00:55:10,880

on with the mission we have a long drive

1175

00:55:15,349 --> 00:55:13,119

we think that it could take if we stop

1176

00:55:17,510 --> 00:55:15,359

to smell the roses a little bit it could

1177

00:55:19,109 --> 00:55:17,520

take till the end of the nominal mission

1178

00:55:21,030 --> 00:55:19,119

and we know that nasa is going to back

1179

00:55:22,950 --> 00:55:21,040

us and and so we have confidence that

1180

00:55:25,589 --> 00:55:22,960

we'll continue on with this great

1181

00:55:39,750 --> 00:55:25,599

exploration mission and uh thanks to

1182

00:55:45,829 --> 00:55:43,750

well thank you john ken bethany enoshwin

1183

00:55:47,829 --> 00:55:45,839

you know the public excitement and

1184

00:55:49,829 --> 00:55:47,839

involvement in this mission is something

1185

00:55:52,309 --> 00:55:49,839

that's really touched us all

1186

00:55:55,910 --> 00:55:52,319

and we have a video now that will remind

1187

00:56:06,630 --> 00:55:55,920

us of some of the events which show how

1188

00:56:10,870 --> 00:56:08,549

this big huge parachute that we've got

1189

00:56:12,390 --> 00:56:10,880

it'll only slow us down to about 200

1190

00:56:13,990 --> 00:56:12,400

miles an hour but we've got to cut it

1191

00:56:25,589 --> 00:56:14,000

off

1192

00:56:30,470 --> 00:56:28,470

nation it is a proud day for america our

1193

00:56:32,150 --> 00:56:30,480

flags are flying and we're singing that

1194

00:56:34,069 --> 00:56:32,160

verse of the national anthem of all the

1195

00:56:37,589 --> 00:56:34,079

curse words in this

1196

00:56:41,349 --> 00:56:37,599

because at 1 30 a.m america standard

1197

00:56:46,630 --> 00:56:41,359

time nasa's curiosity rover touched down

1198

00:56:46,640 --> 00:57:04,069

this

1199

00:57:07,670 --> 00:57:05,910

base nerds and gamers

1200

00:57:10,549 --> 00:57:07,680

the space agency has teamed up with

1201
00:57:37,829 --> 00:57:10,559
microsoft to create a mars rover landing

1202
00:57:43,190 --> 00:57:41,190
we are more than proud to honor nasa's

1203
00:57:45,829 --> 00:57:43,200
jet propulsion laboratory as this year's

1204
00:58:29,190 --> 00:57:45,839
webby and people's voice winner for

1205
00:58:29,200 --> 00:58:42,150
and we know it

1206
00:58:46,710 --> 00:58:44,470
if you want to know whether curiosity is

1207
00:58:48,630 --> 00:58:46,720
part of the culture of the world i think

1208
00:58:50,549 --> 00:58:48,640
that pretty much sums it up the answer

1209
00:58:53,109 --> 00:58:50,559
is you bet

1210
00:58:56,870 --> 00:58:53,119
uh you know more people have been

1211
00:58:58,950 --> 00:58:56,880
involved in the stories of curiosity

1212
00:59:02,309 --> 00:58:58,960
than in any mission that we've sent to a

1213
00:59:04,789 --> 00:59:02,319

planet yet and one of the people who has

1214

00:59:06,870 --> 00:59:04,799

played such a critical role in getting

1215

00:59:08,630 --> 00:59:06,880

out to the world the stories of

1216

00:59:10,549 --> 00:59:08,640

curiosity

1217

00:59:14,309 --> 00:59:10,559

is the manager

1218

00:59:15,589 --> 00:59:14,319

of news and social media for jpl

1219

00:59:25,670 --> 00:59:15,599

please welcome

1220

00:59:29,190 --> 00:59:27,270

i have to start off well first let me

1221

00:59:30,069 --> 00:59:29,200

introduce the um the rest of my panel up

1222

00:59:32,069 --> 00:59:30,079

here because we're gonna have a lot of

1223

00:59:33,430 --> 00:59:32,079

fun talking about social media and means

1224

00:59:35,190 --> 00:59:33,440

and everything else i have babak

1225

00:59:37,589 --> 00:59:35,200

ferdowsi of course he was flight

1226

00:59:40,870 --> 00:59:37,599

director on landing knight

1227

00:59:43,190 --> 00:59:40,880

adam steltzner the phase lead for entry

1228

00:59:46,630 --> 00:59:43,200

descent and landing

1229

00:59:48,549 --> 00:59:46,640

and anita sengupta the parachute systems

1230

00:59:49,349 --> 00:59:48,559

engineer for curiosity

1231

00:59:51,030 --> 00:59:49,359

so we're going to have a little

1232

00:59:53,030 --> 00:59:51,040

conversation about social media but i

1233

00:59:55,190 --> 00:59:53,040

want to start out by saying that

1234

00:59:56,069 --> 00:59:55,200

this entire campaign to make this

1235

00:59:58,470 --> 00:59:56,079

mission

1236

01:00:01,190 --> 00:59:58,480

um ingrained in the in the public and in

1237

01:00:02,549 --> 01:00:01,200

popular culture and to engage the public

1238

01:00:04,789 --> 01:00:02,559

and bring them into this mission has

1239

01:00:07,510 --> 01:00:04,799

been an incredible effort across the

1240

01:00:08,789 --> 01:00:07,520

laboratory and it's not just

1241

01:00:10,710 --> 01:00:08,799

my group

1242

01:00:12,549 --> 01:00:10,720

doing news and social media but the

1243

01:00:15,510 --> 01:00:12,559

outreach team public engagement the

1244

01:00:16,870 --> 01:00:15,520

visualization experts the videographers

1245

01:00:19,990 --> 01:00:16,880

and editors

1246

01:00:22,470 --> 01:00:20,000

and working in conjunction with people

1247

01:00:24,390 --> 01:00:22,480

like these and all of you out there

1248

01:00:26,069 --> 01:00:24,400

because you know that for a few years

1249

01:00:29,109 --> 01:00:26,079

before we even landed we were knocking

1250

01:00:30,870 --> 01:00:29,119

on your doors and asking you to help us

1251

01:00:32,710 --> 01:00:30,880

get that word out to the public and you

1252

01:00:36,230 --> 01:00:32,720

all volunteered your time either doing

1253

01:00:39,190 --> 01:00:36,240

talks or doing chats online uh being

1254

01:00:40,630 --> 01:00:39,200

interviewed for our videos and that made

1255

01:00:42,390 --> 01:00:40,640

all the difference in the world it made

1256

01:00:45,349 --> 01:00:42,400

this a success

1257

01:00:47,190 --> 01:00:45,359

so let's talk a little bit about um

1258

01:00:49,430 --> 01:00:47,200

you know we started out we did curiosity

1259

01:00:51,990 --> 01:00:49,440

cam for those who didn't know we were we

1260

01:00:54,789 --> 01:00:52,000

had a camera up in the gallery while the

1261

01:00:57,109 --> 01:00:54,799

rover was being built we had about 4.5

1262

01:00:59,589 --> 01:00:57,119

million views of that camera

1263

01:01:01,270 --> 01:00:59,599

by the time that we shipped out to ksc

1264

01:01:03,109 --> 01:01:01,280

and that we did a public chat every

1265

01:01:04,950 --> 01:01:03,119

single day that we had that camera up

1266

01:01:06,710 --> 01:01:04,960

there every working day at least

1267

01:01:08,549 --> 01:01:06,720

and then i would say the next big hit

1268

01:01:10,230 --> 01:01:08,559

for the public to get even a bigger

1269

01:01:11,750 --> 01:01:10,240

group involved in the mission was seven

1270

01:01:13,910 --> 01:01:11,760

minutes of terror

1271

01:01:15,829 --> 01:01:13,920

adam anita you two were in seven minutes

1272

01:01:18,630 --> 01:01:15,839

of terror what did you think about the

1273

01:01:20,230 --> 01:01:18,640

impact that video had

1274

01:01:22,630 --> 01:01:20,240

i had a major impact and i think had an

1275

01:01:24,069 --> 01:01:22,640

impact on school children especially so

1276

01:01:25,750 --> 01:01:24,079

i have a lot of educators who are my

1277

01:01:27,190 --> 01:01:25,760

friends who ended up showing that video

1278

01:01:29,349 --> 01:01:27,200

to their school children and made them

1279

01:01:31,349 --> 01:01:29,359

all want to be engineers and scientists

1280

01:01:33,270 --> 01:01:31,359

and are incredibly interested in mars

1281

01:01:35,190 --> 01:01:33,280

exploration so

1282

01:01:36,950 --> 01:01:35,200

yeah i was i was surprised i can

1283

01:01:39,270 --> 01:01:36,960

remember when

1284

01:01:41,750 --> 01:01:39,280

when uh john was putting the video

1285

01:01:43,910 --> 01:01:41,760

together and it i didn't have any i sent

1286

01:01:44,950 --> 01:01:43,920

sense that it would

1287

01:01:46,069 --> 01:01:44,960

end up

1288

01:01:48,309 --> 01:01:46,079

hitting

1289

01:01:50,069 --> 01:01:48,319

a nerve like it did

1290

01:01:51,829 --> 01:01:50,079

and uh

1291

01:01:53,750 --> 01:01:51,839

and you know forever people are just

1292

01:01:55,750 --> 01:01:53,760

always mentioning the seven minutes of

1293

01:01:57,589 --> 01:01:55,760

terror in fact people were tweeting

1294

01:02:00,390 --> 01:01:57,599

thanks for the terror

1295

01:02:03,349 --> 01:02:00,400

hashtag thanks for terror

1296

01:02:05,270 --> 01:02:03,359

so that's been phenomenal yeah and it

1297

01:02:06,870 --> 01:02:05,280

taught all of us a lot as well and i

1298

01:02:07,990 --> 01:02:06,880

have even heard people here at jpl

1299

01:02:10,630 --> 01:02:08,000

saying they weren't afraid until they

1300

01:02:14,950 --> 01:02:12,470

because all of a sudden you saw it all

1301
01:02:17,270 --> 01:02:14,960
there um every little movement that had

1302
01:02:19,670 --> 01:02:17,280
the river had to take to avoid

1303
01:02:22,470 --> 01:02:19,680
catastrophe it was really exciting now

1304
01:02:25,030 --> 01:02:22,480
the next thing um that we did to engage

1305
01:02:27,349 --> 01:02:25,040
the public in this mission was tweetups

1306
01:02:29,670 --> 01:02:27,359
or nasa socials we did one at launch and

1307
01:02:32,230 --> 01:02:29,680
we did one at landing we had invited

1308
01:02:34,470 --> 01:02:32,240
members of the public to come in here at

1309
01:02:37,109 --> 01:02:34,480
jpl and also at other nasa centers

1310
01:02:39,670 --> 01:02:37,119
across the country for

1311
01:02:41,910 --> 01:02:39,680
an opportunity to interact directly with

1312
01:02:45,109 --> 01:02:41,920
the mission team members and to get a

1313
01:02:46,950 --> 01:02:45,119

tour and go see the mars yard and go see

1314

01:02:49,270 --> 01:02:46,960

the mission control areas it was really

1315

01:02:52,230 --> 01:02:49,280

exciting and you two also spoke at that

1316

01:02:54,549 --> 01:02:52,240

did you um sense also there that uh that

1317

01:02:56,309 --> 01:02:54,559

was making a difference

1318

01:02:57,990 --> 01:02:56,319

oh the tweet of itself oh it was

1319

01:02:59,190 --> 01:02:58,000

incredible yeah i mean the outpouring of

1320

01:03:00,870 --> 01:02:59,200

support we got from the public by our

1321

01:03:02,309 --> 01:03:00,880

twitter i mean it's it's immediate it

1322

01:03:04,470 --> 01:03:02,319

happens within a few seconds of every

1323

01:03:06,470 --> 01:03:04,480

single tweet that goes out but um i've

1324

01:03:07,829 --> 01:03:06,480

had wonderful experiences interacting

1325

01:03:09,109 --> 01:03:07,839

with people from around the country and

1326

01:03:11,109 --> 01:03:09,119

actually around the world because of

1327

01:03:13,109 --> 01:03:11,119

twitter and so i've been able to

1328

01:03:15,349 --> 01:03:13,119

interact with a lot of school children a

1329

01:03:16,950 --> 01:03:15,359

lot of teachers a lot of universities as

1330

01:03:18,150 --> 01:03:16,960

a result of twitter so it was a really

1331

01:03:21,349 --> 01:03:18,160

major impact

1332

01:03:23,589 --> 01:03:21,359

and you um again you were the parachute

1333

01:03:26,470 --> 01:03:23,599

uh systems engineer lead on this we have

1334

01:03:29,109 --> 01:03:26,480

a picture of you doing one of your tests

1335

01:03:31,029 --> 01:03:29,119

out there in the field

1336

01:03:34,309 --> 01:03:31,039

and i can imagine also that that mro

1337

01:03:35,829 --> 01:03:34,319

picture uh that was taken just after or

1338

01:03:37,109 --> 01:03:35,839

taken during landing and release just

1339

01:03:39,990 --> 01:03:37,119

after must have

1340

01:03:41,750 --> 01:03:40,000

had a huge uh impact on on on you just

1341

01:03:44,309 --> 01:03:41,760

seeing that for all of you in fact to

1342

01:03:46,470 --> 01:03:44,319

see that picture come down that night

1343

01:03:47,829 --> 01:03:46,480

but back during the tweet up i remember

1344

01:03:49,349 --> 01:03:47,839

there was a gentleman who asked you a

1345

01:03:51,589 --> 01:03:49,359

question and that kind of set a lot of

1346

01:03:53,750 --> 01:03:51,599

things into motion explain what happened

1347

01:03:55,190 --> 01:03:53,760

oh he had asked how can we get more

1348

01:03:56,789 --> 01:03:55,200

girls involved in engineering and

1349

01:03:58,069 --> 01:03:56,799

science and specifically his daughter he

1350

01:03:59,829 --> 01:03:58,079

wanted to know how that we can do that

1351

01:04:00,950 --> 01:03:59,839

and so as a result a lot of people kind

1352

01:04:02,630 --> 01:04:00,960

of picked up on that and there were

1353

01:04:04,630 --> 01:04:02,640

certain people actually in st louis

1354

01:04:06,309 --> 01:04:04,640

missouri who picked up on that who then

1355

01:04:08,309 --> 01:04:06,319

um had a whole bunch of events that they

1356

01:04:10,630 --> 01:04:08,319

scheduled to support mars exploration

1357

01:04:12,870 --> 01:04:10,640

and curiosity as a result of that so and

1358

01:04:13,910 --> 01:04:12,880

i and now in my spare time i actually do

1359

01:04:15,349 --> 01:04:13,920

a lot of educational outreach

1360

01:04:17,270 --> 01:04:15,359

specifically talking about how to get

1361

01:04:18,789 --> 01:04:17,280

more science and women and girls

1362

01:04:20,470 --> 01:04:18,799

involved in engineering

1363

01:04:22,710 --> 01:04:20,480

we're showing a picture right now of uh

1364

01:04:24,630 --> 01:04:22,720

some of the women uh you've spoken to

1365

01:04:26,549 --> 01:04:24,640

remember what this group was uh

1366

01:04:27,990 --> 01:04:26,559

this was in boston um so i went out to

1367

01:04:29,349 --> 01:04:28,000

boston which is where i went and did my

1368

01:04:30,870 --> 01:04:29,359

undergraduate degree so i went and met

1369

01:04:32,630 --> 01:04:30,880

with all of the engineering students at

1370

01:04:34,230 --> 01:04:32,640

boston university and specifically um

1371

01:04:35,349 --> 01:04:34,240

the engineering um

1372

01:04:36,549 --> 01:04:35,359

female engineering students at boston

1373

01:04:37,829 --> 01:04:36,559

university an opportunity to go to the

1374

01:04:39,750 --> 01:04:37,839

museum of science and talk about

1375

01:04:41,349 --> 01:04:39,760

curiosity and i do a lot of stuff in the

1376

01:04:42,789 --> 01:04:41,359

local la area as well specifically

1377

01:04:44,470 --> 01:04:42,799

talking about how to get more girls

1378

01:04:46,630 --> 01:04:44,480

involved in science and engineering yeah

1379

01:04:47,910 --> 01:04:46,640

something we really need yes

1380

01:04:50,309 --> 01:04:47,920

adam what about you at the tweet up i

1381

01:04:52,150 --> 01:04:50,319

remember you announced uh you were

1382

01:04:55,190 --> 01:04:52,160

starting your twitter again that was my

1383

01:04:56,710 --> 01:04:55,200

first tweet was at the tweet up

1384

01:04:58,150 --> 01:04:56,720

trisha my wife

1385

01:05:00,069 --> 01:04:58,160

strongly recommended that i get a

1386

01:05:01,510 --> 01:05:00,079

twitter account before i went go to the

1387

01:05:03,029 --> 01:05:01,520

tweet up i did

1388

01:05:06,470 --> 01:05:03,039

and

1389

01:05:08,549 --> 01:05:06,480

by

1390

01:05:09,750 --> 01:05:08,559

the following monday i had 8 000

1391

01:05:11,029 --> 01:05:09,760

followers

1392

01:05:13,589 --> 01:05:11,039

of course

1393

01:05:15,910 --> 01:05:13,599

nothing compares

1394

01:05:17,829 --> 01:05:15,920

we're going to get product to to the

1395

01:05:20,069 --> 01:05:17,839

followers that some of us have picked up

1396

01:05:22,230 --> 01:05:20,079

but um

1397

01:05:23,510 --> 01:05:22,240

i was kind of amazed you know it's an

1398

01:05:24,549 --> 01:05:23,520

interesting uh it's actually very

1399

01:05:26,470 --> 01:05:24,559

interesting

1400

01:05:28,309 --> 01:05:26,480

uh communication format the restriction

1401

01:05:30,470 --> 01:05:28,319

of the 140 characters is a little bit

1402

01:05:32,309 --> 01:05:30,480

like a haiku or something you sort of

1403

01:05:33,829 --> 01:05:32,319

condense it into uh

1404

01:05:37,029 --> 01:05:33,839

into a small amount of

1405

01:05:40,069 --> 01:05:37,039

uh of stuff and it's been very

1406

01:05:41,670 --> 01:05:40,079

fun for me to interact with uh with

1407

01:05:43,750 --> 01:05:41,680

a sort of a wide

1408

01:05:46,309 --> 01:05:43,760

variety of folks around the nation and

1409

01:05:49,270 --> 01:05:46,319

actually the world all via this uh small

1410

01:05:51,589 --> 01:05:49,280

little portal it's fun

1411

01:05:52,710 --> 01:05:51,599

so um since then

1412

01:05:55,910 --> 01:05:52,720

tell me a little bit more about your

1413

01:05:57,109 --> 01:05:55,920

role getting word out um since landing i

1414

01:06:01,829 --> 01:05:57,119

know you've actually done i've been

1415

01:06:07,750 --> 01:06:04,549

you know as you see some faces

1416

01:06:09,510 --> 01:06:07,760

sort of there's a big like it's

1417

01:06:10,870 --> 01:06:09,520

you know the lottery bowl where they've

1418

01:06:12,230 --> 01:06:10,880

got a whole bunch of numbers and a

1419

01:06:14,549 --> 01:06:12,240

couple of the ping pong balls with the

1420

01:06:17,510 --> 01:06:14,559

numbers come rolling out well some of

1421

01:06:18,470 --> 01:06:17,520

the faces come rolling out of the random

1422

01:06:21,750 --> 01:06:18,480

you know

1423

01:06:23,829 --> 01:06:21,760

societal interest been and

1424

01:06:25,270 --> 01:06:23,839

and all of a sudden you're exposed to a

1425

01:06:27,029 --> 01:06:25,280

lot of folks a lot of people are looking

1426

01:06:29,029 --> 01:06:27,039

to you for for

1427

01:06:30,789 --> 01:06:29,039

for input about what this means what

1428

01:06:33,190 --> 01:06:30,799

this means for society

1429

01:06:34,870 --> 01:06:33,200

and uh it's been

1430

01:06:35,670 --> 01:06:34,880

very stimulating

1431

01:06:37,750 --> 01:06:35,680

um

1432

01:06:38,710 --> 01:06:37,760

sometimes a bit exhausting

1433

01:06:42,870 --> 01:06:38,720

but

1434

01:06:44,870 --> 01:06:42,880

uh very moving for me uh to see how how

1435

01:06:48,950 --> 01:06:44,880

the curiosity has impacted

1436

01:06:52,390 --> 01:06:48,960

uh our society

1437

01:06:55,029 --> 01:06:52,400

let's talk about you babic

1438

01:06:57,430 --> 01:06:55,039

you were the internet's choice i would

1439

01:06:59,510 --> 01:06:57,440

say and if we had voted a person most

1440

01:07:01,910 --> 01:06:59,520

likely to become a meme before landing

1441

01:07:04,710 --> 01:07:01,920

we might have selected you only we were

1442

01:07:06,870 --> 01:07:04,720

a little bit used to your hairstyle

1443

01:07:09,670 --> 01:07:06,880

but uh i went back and

1444

01:07:11,190 --> 01:07:09,680

you know pictures of you in mission

1445

01:07:13,190 --> 01:07:11,200

control were

1446

01:07:16,150 --> 01:07:13,200

on the internet and circulating a couple

1447

01:07:17,109 --> 01:07:16,160

of hours before we even landed

1448

01:07:19,270 --> 01:07:17,119

did you

1449

01:07:21,510 --> 01:07:19,280

notice anything going on was your phone

1450

01:07:22,789 --> 01:07:21,520

going crazy i got a few texts from

1451

01:07:24,470 --> 01:07:22,799

friends saying hey there's like this

1452

01:07:27,190 --> 01:07:24,480

article about your hair

1453

01:07:30,150 --> 01:07:28,549

but i don't think i really fully

1454

01:07:31,510 --> 01:07:30,160

understood uh what was going on until

1455

01:07:32,549 --> 01:07:31,520

the following i got to point out one

1456

01:07:34,150 --> 01:07:32,559

correction though i was not flight

1457

01:07:35,190 --> 01:07:34,160

director on landing night keith come

1458

01:07:36,710 --> 01:07:35,200

over there

1459

01:07:37,829 --> 01:07:36,720

that gentleman uh keith i don't know if

1460

01:07:53,510 --> 01:07:37,839

you mind standing up and maybe

1461

01:07:57,190 --> 01:07:56,150

uh he did a great job of uh

1462

01:07:59,190 --> 01:07:57,200

controlling the room that night and

1463

01:08:01,270 --> 01:07:59,200

making sure that uh we had adequate time

1464

01:08:03,190 --> 01:08:01,280

to go to the bathroom yeah also also

1465

01:08:05,589 --> 01:08:03,200

getting our jobs on yeah

1466

01:08:07,190 --> 01:08:05,599

um but no so i just you know it was yeah

1467

01:08:09,270 --> 01:08:07,200

it was the next morning when i woke up

1468

01:08:11,670 --> 01:08:09,280

and i you know did the morning routine

1469

01:08:13,750 --> 01:08:11,680

of checking my email and everything else

1470

01:08:14,950 --> 01:08:13,760

and realized my gmail just had thousands

1471

01:08:15,990 --> 01:08:14,960

of messages because i had never turned

1472

01:08:17,349 --> 01:08:16,000

off the future or twitter says hey you

1473

01:08:18,870 --> 01:08:17,359

have a new follower

1474

01:08:20,630 --> 01:08:18,880

um

1475

01:08:22,789 --> 01:08:20,640

because i had like 50 followers before

1476

01:08:24,550 --> 01:08:22,799

you know or maybe like 100 before the

1477

01:08:26,550 --> 01:08:24,560

the night of landing

1478

01:08:29,430 --> 01:08:26,560

little did i realize what was going on

1479

01:08:33,430 --> 01:08:31,189

and what was really interesting about

1480

01:08:35,189 --> 01:08:33,440

that though is uh the doors that that

1481

01:08:37,430 --> 01:08:35,199

opened for you now to become an

1482

01:08:39,189 --> 01:08:37,440

ambassador for the mission

1483

01:08:40,870 --> 01:08:39,199

and to go out and talk to a lot of

1484

01:08:41,829 --> 01:08:40,880

different groups be invited to a lot of

1485

01:08:44,390 --> 01:08:41,839

different

1486

01:08:46,390 --> 01:08:44,400

events like the national science fair

1487

01:08:48,229 --> 01:08:46,400

where you're doing a lot of work now

1488

01:08:49,990 --> 01:08:48,239

really encouraging and supporting

1489

01:08:52,149 --> 01:08:50,000

students to get involved in in

1490

01:08:54,309 --> 01:08:52,159

engineering and science tell us about

1491

01:08:55,510 --> 01:08:54,319

some of the great events you've done

1492

01:08:56,550 --> 01:08:55,520

yeah i mean it's been an incredible

1493

01:08:58,950 --> 01:08:56,560

experience and i think one of the

1494

01:08:59,910 --> 01:08:58,960

amazing things for me is just kind of

1495

01:09:01,510 --> 01:08:59,920

showing

1496

01:09:05,669 --> 01:09:01,520

kids and people that you can look

1497

01:09:08,709 --> 01:09:07,590

or scientists and so this is this is a

1498

01:09:10,149 --> 01:09:08,719

picture of me it's mckinley it's

1499

01:09:11,269 --> 01:09:10,159

actually a local school here in pasadena

1500

01:09:12,470 --> 01:09:11,279

but it was just a kind of incredible

1501

01:09:14,709 --> 01:09:12,480

experience they built this whole lego

1502

01:09:16,070 --> 01:09:14,719

model of missions to mars and everything

1503

01:09:17,669 --> 01:09:16,080

and it's really cool to see it they have

1504

01:09:18,789 --> 01:09:17,679

their own little curiosity like road

1505

01:09:21,189 --> 01:09:18,799

where they can drive around and things

1506

01:09:22,950 --> 01:09:21,199

like that um i've just yeah it's been

1507

01:09:24,309 --> 01:09:22,960

such a wonderful experience going out

1508

01:09:25,510 --> 01:09:24,319

there talking to kids seeing the

1509

01:09:27,269 --> 01:09:25,520

excitement they have and i think kids

1510

01:09:28,390 --> 01:09:27,279

are all like really naturally super

1511

01:09:30,390 --> 01:09:28,400

excited but they just don't have

1512

01:09:32,070 --> 01:09:30,400

something to latch onto always

1513

01:09:33,590 --> 01:09:32,080

so it's been it's been you know just

1514

01:09:35,510 --> 01:09:33,600

awesome for me to feel like i can

1515

01:09:36,870 --> 01:09:35,520

actually contribute that and uh you know

1516

01:09:38,149 --> 01:09:36,880

every once in a while some parent will

1517

01:09:39,590 --> 01:09:38,159

like tweet me or send me a picture of

1518

01:09:41,990 --> 01:09:39,600

their kid with a mohawk or tell me that

1519

01:09:43,590 --> 01:09:42,000

the kid wants to get a mohawk yes i

1520

01:09:45,430 --> 01:09:43,600

didn't

1521

01:09:47,269 --> 01:09:45,440

i hope i'm not a bad influence guys i'm

1522

01:09:49,829 --> 01:09:47,279

trying yeah

1523

01:09:51,590 --> 01:09:49,839

um do you all feel that this public

1524

01:09:54,149 --> 01:09:51,600

interest and involvement is still as

1525

01:09:56,470 --> 01:09:54,159

strong today as it was back on landing

1526

01:09:59,750 --> 01:09:56,480

night i'm kind of amazed at the staying

1527

01:10:01,590 --> 01:09:59,760

power i can remember i worked on mer and

1528

01:10:04,790 --> 01:10:01,600

i can remember that we were

1529

01:10:07,270 --> 01:10:04,800

top on cnn's you know things going on

1530

01:10:09,350 --> 01:10:07,280

list for about 36 hours

1531

01:10:11,750 --> 01:10:09,360

and then britney spears got out of a

1532

01:10:13,590 --> 01:10:11,760

limousine wearing an unusual set of

1533

01:10:14,550 --> 01:10:13,600

clothing or not wearing an usual set of

1534

01:10:16,950 --> 01:10:14,560

clothing

1535

01:10:17,990 --> 01:10:16,960

and all of a sudden we were no longer on

1536

01:10:20,709 --> 01:10:18,000

the top

1537

01:10:23,430 --> 01:10:20,719

things to to track and i

1538

01:10:25,910 --> 01:10:23,440

i've i've wondered about that a bit

1539

01:10:31,669 --> 01:10:28,390

maybe that came out wrong

1540

01:10:33,350 --> 01:10:31,679

but that uh i think it really is social

1541

01:10:35,189 --> 01:10:33,360

media you know

1542

01:10:36,470 --> 01:10:35,199

nightly news has four or five things

1543

01:10:38,149 --> 01:10:36,480

they're going to tell you

1544

01:10:39,669 --> 01:10:38,159

and if you're number six

1545

01:10:41,270 --> 01:10:39,679

you didn't happen

1546

01:10:42,709 --> 01:10:41,280

and so

1547

01:10:45,669 --> 01:10:42,719

i'm

1548

01:10:48,470 --> 01:10:45,679

constantly amazed that we

1549

01:10:49,669 --> 01:10:48,480

are out there still sticking i'm still

1550

01:10:52,950 --> 01:10:49,679

having people

1551
01:10:55,110 --> 01:10:52,960
tweet me and and and follow me and

1552
01:10:57,030 --> 01:10:55,120
uh and show up when i talk

1553
01:11:00,070 --> 01:10:57,040
i think that there's a

1554
01:11:01,350 --> 01:11:00,080
a lot of interest out there and and i

1555
01:11:03,510 --> 01:11:01,360
think social media's had a lot to do

1556
01:11:05,110 --> 01:11:03,520
with it i agree well since we are

1557
01:11:06,790 --> 01:11:05,120
talking about social media we did put

1558
01:11:08,229 --> 01:11:06,800
out the question on twitter a few days

1559
01:11:09,430 --> 01:11:08,239
ago asking people to send us some

1560
01:11:10,870 --> 01:11:09,440
questions because we're going to talk

1561
01:11:13,030 --> 01:11:10,880
about social media we might as well do

1562
01:11:17,270 --> 01:11:13,040
it right

1563
01:11:23,110 --> 01:11:19,750

uh i know dr astra which is anita's

1564

01:11:24,709 --> 01:11:23,120

handle on twitter is doing iss research

1565

01:11:26,630 --> 01:11:24,719

or you're working on something that will

1566

01:11:28,229 --> 01:11:26,640

be going to the iss soon and they ask

1567

01:11:29,669 --> 01:11:28,239

what what is everyone else up to so

1568

01:11:31,910 --> 01:11:29,679

really fast tell us what you're doing

1569

01:11:33,110 --> 01:11:31,920

now so i'm a project manager for a

1570

01:11:34,630 --> 01:11:33,120

payload that we're delivering to the

1571

01:11:35,910 --> 01:11:34,640

international space station called the

1572

01:11:38,310 --> 01:11:35,920

cold adam laboratory and it's going to

1573

01:11:40,950 --> 01:11:38,320

demonstrate laser cooling in space

1574

01:11:42,630 --> 01:11:40,960

and form an ultra-cold quantum gas

1575

01:11:44,470 --> 01:11:42,640

oh and let me just say that so spouse

1576

01:11:46,070 --> 01:11:44,480

monkey i met by a twitter and so last

1577

01:11:47,830 --> 01:11:46,080

time i was in houston we actually met up

1578

01:11:50,070 --> 01:11:47,840

in the flush and had pizza and beer

1579

01:11:51,910 --> 01:11:50,080

together

1580

01:11:54,070 --> 01:11:51,920

that's great adam

1581

01:11:57,669 --> 01:11:54,080

i'm doing a variety of trying to help

1582

01:12:00,550 --> 01:11:57,679

out with edl related stuff and uh and

1583

01:12:04,550 --> 01:12:00,560

and thinking about how we might collect

1584

01:12:06,390 --> 01:12:04,560

samples uh for eventual return to earth

1585

01:12:09,030 --> 01:12:06,400

in our next expedition to the surface of

1586

01:12:10,550 --> 01:12:09,040

mars all right mabak i still i'm very

1587

01:12:12,229 --> 01:12:10,560

fortunate to work with a group of people

1588

01:12:13,189 --> 01:12:12,239

who you know operate this this rover on

1589

01:12:14,470 --> 01:12:13,199

mars and

1590

01:12:16,070 --> 01:12:14,480

and uh you know the science team

1591

01:12:17,990 --> 01:12:16,080

everybody has been great about keeping

1592

01:12:19,430 --> 01:12:18,000

us in the loop and learning all the the

1593

01:12:20,550 --> 01:12:19,440

science i don't think i had a real

1594

01:12:21,910 --> 01:12:20,560

appreciation of everything that was

1595

01:12:22,870 --> 01:12:21,920

going to happen on this mission until we

1596

01:12:24,790 --> 01:12:22,880

actually went and they started

1597

01:12:27,590 --> 01:12:24,800

explaining it to us and it's been an

1598

01:12:30,630 --> 01:12:27,600

amazing experience just learning

1599

01:12:32,870 --> 01:12:30,640

actual actual science

1600

01:12:37,030 --> 01:12:32,880

uh let's see

1601
01:12:39,430 --> 01:12:37,040
at poker face 36 0 25 s or chris sheldon

1602
01:12:41,510 --> 01:12:39,440
taylor he asks what is each person's

1603
01:12:44,070 --> 01:12:41,520
favorite picture sent back to earth and

1604
01:12:45,590 --> 01:12:44,080
why oh

1605
01:12:48,470 --> 01:12:45,600
mine's obvious it's the parachute from

1606
01:12:50,630 --> 01:12:48,480
landing night that means it worked

1607
01:12:52,950 --> 01:12:50,640
so that was a relief

1608
01:12:55,910 --> 01:12:52,960
but mine is the very first image the

1609
01:12:57,830 --> 01:12:55,920
rear has cam image that we took back uh

1610
01:12:59,030 --> 01:12:57,840
uh while we were still on the had the

1611
01:13:01,990 --> 01:12:59,040
odyssey link

1612
01:13:03,750 --> 01:13:02,000
the first image of a new place on mars

1613
01:13:05,189 --> 01:13:03,760

i mean i kind of i agree that that

1614

01:13:06,550 --> 01:13:05,199

picture is amazing and that was you know

1615

01:13:07,669 --> 01:13:06,560

the pictures like that from pathfinder

1616

01:13:10,070 --> 01:13:07,679

was some of the reasons why i worked

1617

01:13:11,910 --> 01:13:10,080

here today um i think my favorite

1618

01:13:14,229 --> 01:13:11,920

picture is actually the the

1619

01:13:15,590 --> 01:13:14,239

zoom uh mass cam image of

1620

01:13:17,110 --> 01:13:15,600

the foothills of mount shop and just

1621

01:13:18,790 --> 01:13:17,120

seeing that i mean the incredible

1622

01:13:20,149 --> 01:13:18,800

analogy in my head like that looks like

1623

01:13:21,350 --> 01:13:20,159

the grand canyon that looks like a place

1624

01:13:23,030 --> 01:13:21,360

that i could see here on earth and that

1625

01:13:24,950 --> 01:13:23,040

makes it so much more kind of

1626

01:13:26,070 --> 01:13:24,960

interesting to me i guess like now i can

1627

01:13:27,510 --> 01:13:26,080

start seeing

1628

01:13:29,189 --> 01:13:27,520

you know why it's so exciting that we're

1629

01:13:30,229 --> 01:13:29,199

there

1630

01:13:32,149 --> 01:13:30,239

and you'll probably be able to answer

1631

01:13:35,270 --> 01:13:32,159

this one as well it is what has been the

1632

01:13:36,790 --> 01:13:35,280

most challenging of mars curiosity's

1633

01:13:38,870 --> 01:13:36,800

assignments during its first year on

1634

01:13:41,189 --> 01:13:38,880

mars and since you're still working on

1635

01:13:43,910 --> 01:13:41,199

the team i guess jessica's story earlier

1636

01:13:46,390 --> 01:13:43,920

of the challenge around saw 200 of our

1637

01:13:48,790 --> 01:13:46,400

our computer anomaly was probably one of

1638

01:13:50,310 --> 01:13:48,800

the more exciting and scary things but

1639

01:13:51,350 --> 01:13:50,320

you know we've done a lot of

1640

01:13:52,390 --> 01:13:51,360

we've been fortunate that we've been

1641

01:13:53,669 --> 01:13:52,400

able to do a lot of homework and getting

1642

01:13:55,510 --> 01:13:53,679

ready for the other things like the

1643

01:13:56,630 --> 01:13:55,520

first drill was a tremendous effort from

1644

01:13:58,310 --> 01:13:56,640

the whole team

1645

01:13:59,830 --> 01:13:58,320

um and obviously a lot of effort went

1646

01:14:01,430 --> 01:13:59,840

and worked went into that but i yeah i

1647

01:14:02,390 --> 01:14:01,440

would say that the biggest challenge has

1648

01:14:04,470 --> 01:14:02,400

probably been recovering from that

1649

01:14:06,390 --> 01:14:04,480

there's some folks right over there who

1650

01:14:08,390 --> 01:14:06,400

who are a big part of that

1651
01:14:09,590 --> 01:14:08,400
all right um so we've talked about

1652
01:14:11,750 --> 01:14:09,600
social media definitely has had this

1653
01:14:12,870 --> 01:14:11,760
huge impact with getting our word out

1654
01:14:14,870 --> 01:14:12,880
and not just getting your word out to

1655
01:14:16,310 --> 01:14:14,880
the public but to get them back in and

1656
01:14:18,630 --> 01:14:16,320
get them involved and feel like they can

1657
01:14:19,750 --> 01:14:18,640
hold these conversations but adam why do

1658
01:14:21,669 --> 01:14:19,760
you think

1659
01:14:24,070 --> 01:14:21,679
what's what struck the chord why did

1660
01:14:26,070 --> 01:14:24,080
people start following

1661
01:14:27,750 --> 01:14:26,080
yeah that's a great question i i've been

1662
01:14:29,910 --> 01:14:27,760
actually asking that a lot of myself

1663
01:14:32,149 --> 01:14:29,920

even prior to landing i was asking this

1664

01:14:33,830 --> 01:14:32,159

question of why we do what we're doing

1665

01:14:35,430 --> 01:14:33,840

and why it might make

1666

01:14:37,350 --> 01:14:35,440

might be important for us

1667

01:14:39,030 --> 01:14:37,360

um

1668

01:14:41,110 --> 01:14:39,040

i you know

1669

01:14:43,669 --> 01:14:41,120

earlier in the videos you saw an image

1670

01:14:45,990 --> 01:14:43,679

of of times square at 1 30 in the

1671

01:14:49,270 --> 01:14:46,000

morning on on monday

1672

01:14:51,350 --> 01:14:49,280

with thousands of people waiting to land

1673

01:14:52,709 --> 01:14:51,360

waiting to see if we could successfully

1674

01:14:55,270 --> 01:14:52,719

land

1675

01:14:56,870 --> 01:14:55,280

and although we go there for the science

1676

01:14:58,790 --> 01:14:56,880

questions i don't think they were there

1677

01:15:00,709 --> 01:14:58,800

at 1 30 in the morning because they're

1678

01:15:02,790 --> 01:15:00,719

dying to know about the ph and salinity

1679

01:15:04,390 --> 01:15:02,800

of the ancient aqueous environment on

1680

01:15:06,390 --> 01:15:04,400

the surface of mars

1681

01:15:08,550 --> 01:15:06,400

they're they're there maybe for that but

1682

01:15:11,910 --> 01:15:08,560

for more

1683

01:15:14,550 --> 01:15:11,920

i think when we explore we're kind of

1684

01:15:18,310 --> 01:15:14,560

asking questions about ourselves as

1685

01:15:19,270 --> 01:15:18,320

individuals and as a society as a people

1686

01:15:21,830 --> 01:15:19,280

um

1687

01:15:23,910 --> 01:15:21,840

a neil armstrong i think hinted at that

1688

01:15:26,149 --> 01:15:23,920

with the words that he chose to say when

1689

01:15:28,950 --> 01:15:26,159

he was going to set foot on the surface

1690

01:15:30,070 --> 01:15:28,960

of the moon which was one small step for

1691

01:15:32,709 --> 01:15:30,080

a man

1692

01:15:35,189 --> 01:15:32,719

one giant leap for mankind what he was

1693

01:15:37,590 --> 01:15:35,199

hinting at was that he was carrying us

1694

01:15:40,149 --> 01:15:37,600

with him in that exploration

1695

01:15:41,030 --> 01:15:40,159

i think curiosity carries us with

1696

01:15:43,430 --> 01:15:41,040

her

1697

01:15:47,030 --> 01:15:43,440

when she's on the surface of mars

1698

01:15:49,990 --> 01:15:47,040

and so she helps us ask questions about

1699

01:15:51,990 --> 01:15:50,000

who we are how grand we are what

1700

01:15:54,149 --> 01:15:52,000

questions might we dare ask and hope to

1701

01:15:55,350 --> 01:15:54,159

be able to answer

1702

01:15:59,350 --> 01:15:55,360

so

1703

01:16:02,070 --> 01:15:59,360

sticks is because

1704

01:16:05,110 --> 01:16:02,080

this act of exploration is

1705

01:16:07,270 --> 01:16:05,120

sort of important to us

1706

01:16:09,750 --> 01:16:07,280

i think through it

1707

01:16:10,709 --> 01:16:09,760

we dream a little bigger

1708

01:16:13,110 --> 01:16:10,719

maybe

1709

01:16:15,590 --> 01:16:13,120

aspire a little higher

1710

01:16:18,550 --> 01:16:15,600

and in some sense

1711

01:16:22,229 --> 01:16:18,560

we're a little better a teeny itsy bit

1712

01:16:24,709 --> 01:16:22,239

better so the idea

1713

01:16:27,430 --> 01:16:24,719

that 50 or 100 million people in this

1714

01:16:30,550 --> 01:16:27,440

country are a little bit better

1715

01:16:33,110 --> 01:16:30,560

by the acts that the people in this room

1716

01:16:37,270 --> 01:16:33,120

put our shoulders to to make happen

1717

01:16:37,990 --> 01:16:37,280

is uh it's a tremendous honor for me and

1718

01:16:52,950 --> 01:16:38,000

i

1719

01:17:00,229 --> 01:16:52,960

what else can you say after that so

1720

01:17:02,390 --> 01:17:01,510

well thank you

1721

01:17:06,709 --> 01:17:02,400

veronica

1722

01:17:08,470 --> 01:17:06,719

bobby adam and anita thank you very much

1723

01:17:10,070 --> 01:17:08,480

so as we

1724

01:17:11,590 --> 01:17:10,080

come to the conclusion of our

1725

01:17:13,350 --> 01:17:11,600

celebration

1726

01:17:18,229 --> 01:17:13,360

i'd just like you to reflect for a

1727

01:17:20,790 --> 01:17:18,239

moment how fortunate we are to be

1728

01:17:23,750 --> 01:17:20,800

part of the dawn of earth's adventures

1729

01:17:26,790 --> 01:17:23,760

of the solar system and beyond

1730

01:17:30,070 --> 01:17:26,800

it's truly incredible what we've seen

1731

01:17:32,550 --> 01:17:30,080

from curiosity alone in terms of the

1732

01:17:35,510 --> 01:17:32,560

development of the marvelous tools that

1733

01:17:38,070 --> 01:17:35,520

we now use to explore the planets

1734

01:17:39,430 --> 01:17:38,080

and what we've learned

1735

01:17:41,910 --> 01:17:39,440

so

1736

01:17:44,950 --> 01:17:41,920

i'd just like to thank you for

1737

01:17:46,709 --> 01:17:44,960

participating in our celebration

1738

01:17:48,470 --> 01:17:46,719

i hope that it's given you an

1739

01:17:51,750 --> 01:17:48,480

opportunity to

1740

01:17:54,229 --> 01:17:51,760

think about the scope and magnitude of

1741

01:17:55,510 --> 01:17:54,239

nasa's exceptional team of

1742

01:17:57,030 --> 01:17:55,520

dreamers

1743

01:17:59,110 --> 01:17:57,040

doers

1744

01:18:01,030 --> 01:17:59,120

and what they've accomplished so far and

1745

01:18:03,189 --> 01:18:01,040

what's ahead of us

1746

01:18:04,630 --> 01:18:03,199

so on behalf of

1747

01:18:08,630 --> 01:18:04,640

nasa's

1748

01:18:10,550 --> 01:18:08,640

and caltech's jet propulsion laboratory

1749

01:18:13,669 --> 01:18:10,560

i'd like to

1750

01:18:14,550 --> 01:18:13,679

again say thanks for coming

1751

01:18:17,110 --> 01:18:14,560

there's

1752

01:18:19,990 --> 01:18:17,120

really something to be seen here in a

1753

01:18:22,550 --> 01:18:20,000

little short video we have to close

1754

01:18:25,110 --> 01:18:22,560

that sort of sends us off

1755

01:18:27,350 --> 01:18:25,120

looking at where we've been on mars with

1756

01:18:30,630 --> 01:18:27,360

curiosity by viewing

1757

01:18:31,590 --> 01:18:30,640

mars through the navigation camera

1758

01:18:32,870 --> 01:18:31,600

so

1759

01:18:34,550 --> 01:18:32,880

thanks again

1760

01:18:46,790 --> 01:18:34,560

the adventure of exploring mars

1761

01:18:46,800 --> 01:18:55,990

so

1762

01:18:56,000 --> 01:19:12,390

um

1763

01:19:12,400 --> 01:19:27,430

do

1764

01:24:10,310 --> 01:20:06,070

so

1765

01:24:13,669 --> 01:24:11,669

good afternoon and welcome to nasa

1766

01:24:15,590 --> 01:24:13,679

headquarters i'm nasa public affairs

1767

01:24:17,590 --> 01:24:15,600

officer trent parado

1768

01:24:19,270 --> 01:24:17,600

marks an important day an important

1769

01:24:20,709 --> 01:24:19,280

anniversary in recent nasa history is

1770

01:24:23,270 --> 01:24:20,719

one year ago the mars science

1771

01:24:25,030 --> 01:24:23,280

laboratory's curiosity rover landed on

1772

01:24:28,070 --> 01:24:25,040

mars to begin its mission of scientific

1773

01:24:29,669 --> 01:24:28,080

exploration it dared us all to do

1774

01:24:31,510 --> 01:24:29,679

mighty things and it may have even

1775

01:24:33,270 --> 01:24:31,520

brought back the mohawk we have a very

1776

01:24:35,910 --> 01:24:33,280

exciting event planned for all of you

1777

01:24:37,430 --> 01:24:35,920

today um we will hear a little bit about

1778

01:24:39,270 --> 01:24:37,440

the science and the some of the science

1779

01:24:41,110 --> 01:24:39,280

highlights the mission has enabled uh

1780

01:24:43,030 --> 01:24:41,120

over the last year we'll talk a little

1781

01:24:45,189 --> 01:24:43,040

bit about the robotic follow-on missions

1782

01:24:47,189 --> 01:24:45,199

that'll that are planned for mars in its

1783

01:24:49,270 --> 01:24:47,199

footsteps of course talk about new

1784

01:24:50,629 --> 01:24:49,280

technologies and development at nasa and

1785

01:24:52,709 --> 01:24:50,639

some of the work happening around the

1786

01:24:54,550 --> 01:24:52,719

country and in space to enable that

1787

01:24:56,950 --> 01:24:54,560

ultimate agency goal of a human mission

1788

01:24:58,870 --> 01:24:56,960

to mars in the 2030s this will of course

1789

01:25:00,950 --> 01:24:58,880

include a very special and rare

1790

01:25:03,030 --> 01:25:00,960

opportunity to talk to chris cassidy and

1791

01:25:04,310 --> 01:25:03,040

karen nyberg who are currently the two

1792

01:25:05,830 --> 01:25:04,320

u.s crew members aboard the

1793

01:25:07,910 --> 01:25:05,840

international space station for

1794

01:25:09,830 --> 01:25:07,920

expedition 36 so that'll be a fun

1795

01:25:12,149 --> 01:25:09,840

opportunity we're looking forward to it

1796

01:25:13,430 --> 01:25:12,159

so if you're joining us online you can

1797

01:25:15,830 --> 01:25:13,440

of course find out more about the

1798

01:25:19,030 --> 01:25:15,840

mission at nasa.gov curiosity you can

1799

01:25:21,350 --> 01:25:19,040

ask us questions uh on social media you

1800

01:25:23,990 --> 01:25:21,360

can uh find us at nasa and at mars

1801
01:25:26,310 --> 01:25:24,000
curiosity and of course you can um use

1802
01:25:28,790 --> 01:25:26,320
the hashtag one year on mars to join the

1803
01:25:31,030 --> 01:25:28,800
conversation there use the hashtag

1804
01:25:33,110 --> 01:25:31,040
asknasa excuse me if you have questions

1805
01:25:35,270 --> 01:25:33,120
for us and our speakers as we go through

1806
01:25:37,189 --> 01:25:35,280
the event so we're going to start off

1807
01:25:39,350 --> 01:25:37,199
the event by talking a bit about science

1808
01:25:41,510 --> 01:25:39,360
our first speaker directs the planetary

1809
01:25:43,430 --> 01:25:41,520
portfolio at nasa that means every

1810
01:25:45,590 --> 01:25:43,440
mission on or around other planets in

1811
01:25:48,149 --> 01:25:45,600
the solar system even the not a planet

1812
01:25:49,990 --> 01:25:48,159
pluto we have a mission headed there but

1813
01:25:51,910 --> 01:25:50,000

it certainly includes the current and

1814

01:25:53,750 --> 01:25:51,920

planned fall-on missions to mars

1815

01:25:55,030 --> 01:25:53,760

officially he is the planetary division

1816

01:25:56,390 --> 01:25:55,040

director for the science mission

1817

01:25:58,390 --> 01:25:56,400

director here at nasa headquarters in

1818

01:26:03,510 --> 01:25:58,400

washington please help me welcome nasa's

1819

01:26:08,070 --> 01:26:05,110

thank you

1820

01:26:11,350 --> 01:26:08,080

indeed i want to welcome you on our

1821

01:26:13,510 --> 01:26:11,360

first anniversary uh of curiosity

1822

01:26:18,870 --> 01:26:13,520

landing on mars and if i could have my

1823

01:26:23,110 --> 01:26:21,750

there we go and in particular i want to

1824

01:26:26,390 --> 01:26:23,120

talk to

1825

01:26:27,750 --> 01:26:26,400

that new generation domar's generation

1826
01:26:29,510 --> 01:26:27,760
these are

1827
01:26:31,110 --> 01:26:29,520
our individuals

1828
01:26:33,910 --> 01:26:31,120
that believe

1829
01:26:35,350 --> 01:26:33,920
and will be going with us to mars

1830
01:26:36,550 --> 01:26:35,360
they of course

1831
01:26:38,870 --> 01:26:36,560
perhaps will

1832
01:26:41,110 --> 01:26:38,880
think of mars in this way standing on

1833
01:26:44,470 --> 01:26:41,120
the surface looking back at the earth

1834
01:26:47,030 --> 01:26:44,480
so the mars generation is here today

1835
01:26:48,310 --> 01:26:47,040
and our plans are indeed to put humans

1836
01:26:51,110 --> 01:26:48,320
on mars

1837
01:26:52,950 --> 01:26:51,120
next slide please what i'd like to do

1838
01:26:55,350 --> 01:26:52,960

as we go through this

1839

01:26:56,550 --> 01:26:55,360

is really talk about some of the past

1840

01:26:59,030 --> 01:26:56,560

missions

1841

01:27:01,430 --> 01:26:59,040

uh for us to be able to put humans on

1842

01:27:03,910 --> 01:27:01,440

mars we have to take steps

1843

01:27:05,510 --> 01:27:03,920

and for our first rover step here is

1844

01:27:08,550 --> 01:27:05,520

pathfinder

1845

01:27:10,790 --> 01:27:08,560

and of course you called it sojourner

1846

01:27:13,030 --> 01:27:10,800

it's our first major step to mars and we

1847

01:27:15,590 --> 01:27:13,040

learned so much about how to rove on

1848

01:27:17,750 --> 01:27:15,600

mars and and much more about the

1849

01:27:19,510 --> 01:27:17,760

environment that existed in and as you

1850

01:27:21,750 --> 01:27:19,520

can see in the map you can see where

1851
01:27:23,750 --> 01:27:21,760
sojourner or pathfinder

1852
01:27:26,470 --> 01:27:23,760
was located on mars

1853
01:27:30,070 --> 01:27:28,629
our next environment

1854
01:27:31,350 --> 01:27:30,080
was indeed

1855
01:27:34,790 --> 01:27:31,360
this one

1856
01:27:37,189 --> 01:27:34,800
this is the mars exploration rover uh

1857
01:27:38,870 --> 01:27:37,199
you named it curiosity we had another

1858
01:27:40,629 --> 01:27:38,880
one called spirit

1859
01:27:43,189 --> 01:27:40,639
and these as you can see in the

1860
01:27:44,629 --> 01:27:43,199
particular graphics show us where spirit

1861
01:27:49,110 --> 01:27:44,639
and opportunity

1862
01:27:52,070 --> 01:27:49,120
spirit unfortunately is no longer

1863
01:27:55,030 --> 01:27:52,080

operating but opportunity is doing well

1864

01:27:57,910 --> 01:27:55,040

it's wintering over right now as we move

1865

01:28:00,629 --> 01:27:57,920

from summer into into the winter season

1866

01:28:01,590 --> 01:28:00,639

and it's doing a great job living 10

1867

01:28:03,350 --> 01:28:01,600

years

1868

01:28:05,510 --> 01:28:03,360

in a time when we only thought it might

1869

01:28:09,110 --> 01:28:05,520

live three or four months

1870

01:28:11,350 --> 01:28:09,120

our latest rover of course is curiosity

1871

01:28:14,709 --> 01:28:11,360

now this is a nice little mock-up of

1872

01:28:17,189 --> 01:28:14,719

curiosity it's huge it's about the size

1873

01:28:19,590 --> 01:28:17,199

of your suv and even this doesn't do it

1874

01:28:21,910 --> 01:28:19,600

justice the top of curiosity is actually

1875

01:28:24,070 --> 01:28:21,920

here and as a six foot individual i have

1876

01:28:26,070 --> 01:28:24,080

to look up to curiosity

1877

01:28:28,950 --> 01:28:26,080

uh here's one of the wheels

1878

01:28:30,790 --> 01:28:28,960

this is a wheel that we used for testing

1879

01:28:32,709 --> 01:28:30,800

and as you can see it's gone through the

1880

01:28:35,430 --> 01:28:32,719

batter test but that was of course

1881

01:28:37,430 --> 01:28:35,440

necessary for us to test all elements of

1882

01:28:39,830 --> 01:28:37,440

that seven minutes of terror and

1883

01:28:42,550 --> 01:28:39,840

actually making that landing going from

1884

01:28:44,790 --> 01:28:42,560

thirteen thousand miles per hour when it

1885

01:28:46,629 --> 01:28:44,800

hit the top of the atmosphere to only

1886

01:28:49,750 --> 01:28:46,639

inches per second when it actually

1887

01:28:51,669 --> 01:28:49,760

landed and of course it landed safely uh

1888

01:28:53,830 --> 01:28:51,679

this time one year ago

1889

01:28:57,110 --> 01:28:53,840

and not only as we're going to find out

1890

01:29:00,390 --> 01:28:57,120

is it discovering the past of mars it's

1891

01:29:03,750 --> 01:29:00,400

actually making major discoveries about

1892

01:29:04,870 --> 01:29:03,760

what mars is like today that's important

1893

01:29:06,149 --> 01:29:04,880

because

1894

01:29:07,830 --> 01:29:06,159

our future

1895

01:29:09,750 --> 01:29:07,840

is really

1896

01:29:12,870 --> 01:29:09,760

in our hands

1897

01:29:15,430 --> 01:29:12,880

our destiny is to leave low earth orbit

1898

01:29:19,430 --> 01:29:15,440

trek out into the solar system the solar

1899

01:29:22,550 --> 01:29:19,440

system is ours let's take it and and we

1900

01:29:24,790 --> 01:29:22,560

believe humans can actually land on mars

1901

01:29:27,910 --> 01:29:24,800

as that ultimate destination for humans

1902

01:29:29,669 --> 01:29:27,920

within 20 perhaps 30 years from now

1903

01:29:31,590 --> 01:29:29,679

so let me now talk more about the

1904

01:29:38,149 --> 01:29:31,600

science

1905

01:29:42,470 --> 01:29:40,149

here's where we chose

1906

01:29:44,629 --> 01:29:42,480

for curiosity to land

1907

01:29:46,470 --> 01:29:44,639

it's called gale crater

1908

01:29:48,470 --> 01:29:46,480

and as you can see in this color

1909

01:29:51,110 --> 01:29:48,480

rendition of height

1910

01:29:54,870 --> 01:29:51,120

the lowlands are blue the highlands are

1911

01:29:56,950 --> 01:29:54,880

on the order of green and also red and

1912

01:29:59,430 --> 01:29:56,960

it's at that boundary between lowlands

1913

01:30:01,590 --> 01:29:59,440

and highlands we picked that particular

1914

01:30:04,229 --> 01:30:01,600

area because we wanted to go for

1915

01:30:06,390 --> 01:30:04,239

understanding if mars had a very wet

1916

01:30:08,709 --> 01:30:06,400

history in its past we see a lot of

1917

01:30:12,070 --> 01:30:08,719

indications that mars has had water on

1918

01:30:14,229 --> 01:30:12,080

its surface but we really wanted to see

1919

01:30:16,229 --> 01:30:14,239

if water could have existed for long

1920

01:30:18,709 --> 01:30:16,239

periods of time this seemed to be the

1921

01:30:20,310 --> 01:30:18,719

perfect place it's a low land area and

1922

01:30:23,110 --> 01:30:20,320

that of course is where water would

1923

01:30:24,950 --> 01:30:23,120

exist next slide please

1924

01:30:28,229 --> 01:30:24,960

here's where we landed

1925

01:30:31,110 --> 01:30:28,239

right smack dab in our bull's-eye

1926

01:30:33,830 --> 01:30:31,120

called a gale crater you can see where

1927

01:30:35,990 --> 01:30:33,840

curiosity is as pointed here you can see

1928

01:30:38,550 --> 01:30:36,000

where the jets from the sky crane blew

1929

01:30:41,270 --> 01:30:38,560

away the top soil you can see that the

1930

01:30:43,990 --> 01:30:41,280

sky crane uh actually detached and

1931

01:30:46,470 --> 01:30:44,000

crashed much further away

1932

01:30:48,709 --> 01:30:46,480

but you also see areas like this

1933

01:30:51,510 --> 01:30:48,719

fractured unit and this cratered unit in

1934

01:30:54,629 --> 01:30:51,520

this hammocky unit mars was in this

1935

01:30:56,629 --> 01:30:54,639

location was just a fabulous opportunity

1936

01:30:59,350 --> 01:30:56,639

for us to take a really good look at

1937

01:31:01,510 --> 01:30:59,360

what's around us next slide please

1938

01:31:04,950 --> 01:31:01,520

and and of course we took our own beauty

1939

01:31:06,950 --> 01:31:04,960

picture this is uh 54 frames from our

1940

01:31:09,590 --> 01:31:06,960

our arm camera

1941

01:31:12,390 --> 01:31:09,600

and uh someone in the community uh on

1942

01:31:14,550 --> 01:31:12,400

the internet did this next slide please

1943

01:31:17,189 --> 01:31:14,560

put the picture together and gave us

1944

01:31:19,430 --> 01:31:17,199

gave us a great look of curiosity on its

1945

01:31:22,070 --> 01:31:19,440

surface next slide please

1946

01:31:24,550 --> 01:31:22,080

all curiosity had to do now was to look

1947

01:31:26,950 --> 01:31:24,560

around wake up get its instruments up

1948

01:31:28,709 --> 01:31:26,960

and running it looked north towards that

1949

01:31:30,470 --> 01:31:28,719

crater rim and of course on the other

1950

01:31:33,110 --> 01:31:30,480

side of the crater rim

1951

01:31:34,870 --> 01:31:33,120

is that very low lying area

1952

01:31:38,470 --> 01:31:34,880

in fact we see

1953

01:31:40,470 --> 01:31:38,480

from orbit major scours that that exist

1954

01:31:43,030 --> 01:31:40,480

in that crater room where water perhaps

1955

01:31:44,550 --> 01:31:43,040

poured over and into the crater itself

1956

01:31:47,350 --> 01:31:44,560

next slide please

1957

01:31:50,149 --> 01:31:47,360

it also looked towards mount sharp

1958

01:31:51,510 --> 01:31:50,159

here is its ultimate destination next

1959

01:31:54,550 --> 01:31:51,520

slide please

1960

01:31:57,030 --> 01:31:54,560

what's really fabulous about mount sharp

1961

01:31:59,270 --> 01:31:57,040

are these structures these linear

1962

01:32:00,870 --> 01:31:59,280

structures that run across these are

1963

01:32:03,990 --> 01:32:00,880

layered sediments

1964

01:32:07,110 --> 01:32:04,000

where geologists call this stratigraphy

1965

01:32:09,510 --> 01:32:07,120

this is literally the pages of the

1966

01:32:11,350 --> 01:32:09,520

history book on mars

1967

01:32:14,229 --> 01:32:11,360

by going to mount sharp we're going to

1968

01:32:16,870 --> 01:32:14,239

be able to unravel that history and look

1969

01:32:19,110 --> 01:32:16,880

at what happened over time and why

1970

01:32:21,990 --> 01:32:19,120

mars's climate is so different than what

1971

01:32:24,470 --> 01:32:22,000

we believe it existed 4 billion years

1972

01:32:26,709 --> 01:32:24,480

ago next slide please

1973

01:32:29,350 --> 01:32:26,719

this little boulder that we point out

1974

01:32:31,750 --> 01:32:29,360

this little tiny boulder that's sitting

1975

01:32:36,149 --> 01:32:31,760

in front of us is actually the size of

1976

01:32:37,910 --> 01:32:36,159

curiosity our one ton suv sized vehicle

1977

01:32:39,990 --> 01:32:37,920

next slide please

1978

01:32:43,030 --> 01:32:40,000

curiosity began immediately to look

1979

01:32:44,709 --> 01:32:43,040

around and begin its science phase and

1980

01:32:46,550 --> 01:32:44,719

here's what it found

1981

01:32:48,470 --> 01:32:46,560

on the right we see

1982

01:32:51,430 --> 01:32:48,480

similar structures on earth these are

1983

01:32:55,590 --> 01:32:51,440

conglomerates of rounded pebbles

1984

01:32:57,910 --> 01:32:55,600

these are found in dried up river beds

1985

01:33:00,550 --> 01:32:57,920

on the right we see exactly the same

1986

01:33:03,350 --> 01:33:00,560

thing where curiosity is sitting and in

1987

01:33:06,149 --> 01:33:03,360

fact we now believe that curiosity

1988

01:33:08,390 --> 01:33:06,159

landed in an ancient riverbed

1989

01:33:09,910 --> 01:33:08,400

water that flowed in this area billions

1990

01:33:12,790 --> 01:33:09,920

of years ago

1991

01:33:14,790 --> 01:33:12,800

maybe for tens of thousands and millions

1992

01:33:17,030 --> 01:33:14,800

of years flowed in this particular

1993

01:33:19,110 --> 01:33:17,040

region next slide please

1994

01:33:20,950 --> 01:33:19,120

well this was exciting discoveries and

1995

01:33:22,709 --> 01:33:20,960

now we turned our attention to the next

1996

01:33:24,790 --> 01:33:22,719

set of experiments

1997

01:33:27,830 --> 01:33:24,800

and that's where the arm could sit down

1998

01:33:30,310 --> 01:33:27,840

on a particular location on a rock and

1999

01:33:32,790 --> 01:33:30,320

drill next slide please

2000

01:33:34,790 --> 01:33:32,800

and so here's the rock that we chose

2001

01:33:37,189 --> 01:33:34,800

this is a sedimentary rock this is

2002

01:33:39,030 --> 01:33:37,199

material that's been laid over time at

2003

01:33:41,510 --> 01:33:39,040

the bottom of what we believe is this

2004

01:33:43,830 --> 01:33:41,520

ancient riverbed next slide

2005

01:33:46,310 --> 01:33:43,840

it drilled this hole and as we get

2006

01:33:49,750 --> 01:33:46,320

closer to it next slide

2007

01:33:52,229 --> 01:33:49,760

we see quite clearly that mars is a

2008

01:33:53,350 --> 01:33:52,239

different color underneath this red

2009

01:33:55,270 --> 01:33:53,360

surface

2010

01:33:57,590 --> 01:33:55,280

this is gray mars

2011

01:34:00,229 --> 01:33:57,600

this is mars of the past

2012

01:34:01,510 --> 01:34:00,239

when we began to analyze this data next

2013

01:34:03,270 --> 01:34:01,520

slide please

2014

01:34:06,229 --> 01:34:03,280

putting it in our scoop and putting it

2015

01:34:09,030 --> 01:34:06,239

in our sophisticated science instruments

2016

01:34:11,669 --> 01:34:09,040

we found carbon we found nitrogen we

2017

01:34:14,229 --> 01:34:11,679

found oxygen we found phosphorus we

2018

01:34:16,390 --> 01:34:14,239

found sulfur we found all the

2019

01:34:18,229 --> 01:34:16,400

ingredients of life

2020

01:34:21,750 --> 01:34:18,239

as measured in this material that's

2021

01:34:25,990 --> 01:34:21,760

deposited in this ancient riverbed

2022

01:34:29,189 --> 01:34:26,000

mars was habitable in its past

2023

01:34:31,270 --> 01:34:29,199

mars was a blue planet

2024

01:34:34,310 --> 01:34:31,280

this has really been a major step

2025

01:34:36,310 --> 01:34:34,320

forward in understanding that mars was

2026

01:34:39,030 --> 01:34:36,320

much more like earth

2027

01:34:41,030 --> 01:34:39,040

many billions of years ago and of course

2028

01:34:43,189 --> 01:34:41,040

now we want to understand what happened

2029

01:34:44,629 --> 01:34:43,199

to it how did it change from the

2030

01:34:47,910 --> 01:34:44,639

environment that was much more

2031

01:34:49,430 --> 01:34:47,920

earth-like to what it is today

2032

01:34:51,750 --> 01:34:49,440

very dry

2033

01:34:54,149 --> 01:34:51,760

and in fact the atmosphere is only a

2034

01:34:56,550 --> 01:34:54,159

percent of what ours is in terms of its

2035

01:34:58,830 --> 01:34:56,560

pressure and it has quite a bit of

2036

01:35:02,149 --> 01:34:58,840

difference in composition next slide

2037

01:35:04,550 --> 01:35:02,159

please here's our destination

2038

01:35:06,310 --> 01:35:04,560

it's called mount sharp as seen from our

2039

01:35:09,110 --> 01:35:06,320

mars reconnaissance orbiter we're

2040

01:35:11,910 --> 01:35:09,120

looking down now in the bottom of gale

2041

01:35:13,590 --> 01:35:11,920

crater near the landing site you can see

2042

01:35:16,470 --> 01:35:13,600

where we went to glenelg and that's

2043

01:35:18,950 --> 01:35:16,480

where we found the conglomerates and and

2044

01:35:20,950 --> 01:35:18,960

did the analysis i just referred to

2045

01:35:23,270 --> 01:35:20,960

we're heading towards the base of mount

2046

01:35:26,870 --> 01:35:23,280

sharp right now we're moving anywhere

2047

01:35:29,189 --> 01:35:26,880

from 40 meters to 100 meters per day

2048

01:35:30,950 --> 01:35:29,199

now this is about a journey of eight or

2049

01:35:33,510 --> 01:35:30,960

so kilometers so it's going to be

2050

01:35:35,910 --> 01:35:33,520

several months and along the way we'll

2051

01:35:38,310 --> 01:35:35,920

find some fascinating things i know

2052

01:35:40,709 --> 01:35:38,320

once we get to the bottom of mount sharp

2053

01:35:43,350 --> 01:35:40,719

we're going to have to avoid this this

2054

01:35:44,790 --> 01:35:43,360

black area that you see this actually is

2055

01:35:47,510 --> 01:35:44,800

our sand dunes

2056

01:35:48,550 --> 01:35:47,520

from orbit we see these sand dunes shift

2057

01:35:50,629 --> 01:35:48,560

around

2058

01:35:53,189 --> 01:35:50,639

and of course as every good golfer knows

2059

01:35:55,110 --> 01:35:53,199

we want to stay away from those maneuver

2060

01:35:58,629 --> 01:35:55,120

through those and begin to crawl up

2061

01:36:02,070 --> 01:35:58,639

mount sharp and begin to analyze these

2062

01:36:03,750 --> 01:36:02,080

layers of history this stratigraphy the

2063

01:36:05,750 --> 01:36:03,760

laying down of sediments that have

2064

01:36:08,229 --> 01:36:05,760

occurred over billions of years and

2065

01:36:11,750 --> 01:36:08,239

putting all that together will enable us

2066

01:36:14,149 --> 01:36:11,760

to understand what happened to mars

2067

01:36:17,110 --> 01:36:14,159

going from a habitable environment as we

2068

01:36:19,030 --> 01:36:17,120

now believe it was in its past

2069

01:36:21,189 --> 01:36:19,040

to what it is like today

2070

01:36:23,590 --> 01:36:21,199

and of course today

2071

01:36:26,629 --> 01:36:23,600

that is important data for us to be able

2072

01:36:28,790 --> 01:36:26,639

to understand next slide please what our

2073

01:36:31,030 --> 01:36:28,800

future might look like

2074

01:36:33,750 --> 01:36:31,040

now this actually i i pulled off the

2075

01:36:35,669 --> 01:36:33,760

internet only days after this particular

2076

01:36:38,790 --> 01:36:35,679

picture was taken

2077

01:36:40,070 --> 01:36:38,800

someone from the mars generation

2078

01:36:43,669 --> 01:36:40,080

made this

2079

01:36:46,470 --> 01:36:43,679

beautiful image of course it is it is uh

2080

01:36:48,629 --> 01:36:46,480

overlaid with the uh with the shadow of

2081

01:36:49,830 --> 01:36:48,639

curiosity late in the day as the sun

2082

01:36:52,149 --> 01:36:49,840

went down

2083

01:36:54,709 --> 01:36:52,159

taking their transformer and a shadow of

2084

01:36:57,109 --> 01:36:54,719

that photoshop this in

2085

01:36:59,990 --> 01:36:57,119

but in reality this is what humans are

2086

01:37:01,750 --> 01:37:00,000

going to look like in 30 years on mars

2087

01:37:04,070 --> 01:37:01,760

they're going to have communication with

2088

01:37:06,550 --> 01:37:04,080

their orbiters they're going to be

2089

01:37:08,629 --> 01:37:06,560

having a set of tools they're going to

2090

01:37:10,709 --> 01:37:08,639

be working on mars they're going to be

2091

01:37:13,030 --> 01:37:10,719

living on mars and of course they're

2092

01:37:16,070 --> 01:37:13,040

going to have their pet dog rover right

2093

01:37:17,830 --> 01:37:16,080

there in hand helping them along the way

2094

01:37:20,390 --> 01:37:17,840

the next major mission that we're

2095

01:37:23,750 --> 01:37:20,400

thinking of along this path

2096

01:37:25,830 --> 01:37:23,760

is a rover much like curiosity in terms

2097

01:37:28,310 --> 01:37:25,840

of its volume its size

2098

01:37:30,870 --> 01:37:28,320

and its mass however it will have a

2099

01:37:34,149 --> 01:37:30,880

completely different set of instruments

2100

01:37:37,350 --> 01:37:34,159

we're planning to launch that in 2020

2101

01:37:39,830 --> 01:37:37,360

we're planning to take that next step

2102

01:37:42,229 --> 01:37:39,840

knowing that mars was an environment

2103

01:37:44,790 --> 01:37:42,239

that was habitable in its past

2104

01:37:46,390 --> 01:37:44,800

we're going to start seeking the signs

2105

01:37:48,950 --> 01:37:46,400

of potential life

2106

01:37:51,590 --> 01:37:48,960

that could have existed on mars

2107

01:37:54,950 --> 01:37:51,600

and that if we can answer that question

2108

01:37:57,430 --> 01:37:54,960

will change everything it will tell us

2109

01:38:00,629 --> 01:37:57,440

that life not only may exist in our

2110

01:38:03,189 --> 01:38:00,639

solar system but throughout our universe

2111

01:38:05,590 --> 01:38:03,199

so these are huge steps

2112

01:38:07,590 --> 01:38:05,600

and we're making great progress and so

2113

01:38:09,109 --> 01:38:07,600

for all of you we want to take you along

2114

01:38:11,109 --> 01:38:09,119

in the journey

2115

01:38:12,950 --> 01:38:11,119

so with that maybe i can take some

2116

01:38:13,990 --> 01:38:12,960

questions in the time i have remaining

2117

01:38:16,950 --> 01:38:14,000

thanks very much we had a couple of

2118

01:38:18,229 --> 01:38:16,960

roving mics and i think we have

2119

01:38:19,910 --> 01:38:18,239

let's see do we have our first question

2120

01:38:23,109 --> 01:38:19,920

down here in the front

2121

01:38:28,070 --> 01:38:26,310

jeff wallace rock and uh 528 on twitter

2122

01:38:30,870 --> 01:38:28,080

uh so

2123

01:38:33,430 --> 01:38:30,880

what would be your uh what would be your

2124

01:38:35,350 --> 01:38:33,440

your top three uh

2125

01:38:37,350 --> 01:38:35,360

biggest challenges and things that

2126

01:38:38,229 --> 01:38:37,360

you're now happy about

2127

01:38:40,310 --> 01:38:38,239

okay

2128

01:38:43,030 --> 01:38:40,320

the top three challenges

2129

01:38:44,950 --> 01:38:43,040

are indeed making sure that all the

2130

01:38:47,669 --> 01:38:44,960

systems are put together in much the

2131

01:38:50,709 --> 01:38:47,679

same way that we have with curiosity to

2132

01:38:53,189 --> 01:38:50,719

be able to get that next rover down

2133

01:38:55,990 --> 01:38:53,199

also be able to get the right set of

2134

01:38:58,229 --> 01:38:56,000

experiments together that do that major

2135

01:39:00,470 --> 01:38:58,239

step in seeking signs of life that would

2136

01:39:02,229 --> 01:39:00,480

be the next major one and then of course

2137

01:39:04,709 --> 01:39:02,239

we have to find the location that we

2138

01:39:07,030 --> 01:39:04,719

want to go to and like real estate it's

2139

01:39:09,350 --> 01:39:07,040

location location location

2140

01:39:12,470 --> 01:39:09,360

you know the vikings uh in the in the

2141

01:39:14,310 --> 01:39:12,480

80s when they sat down on mars and they

2142

01:39:16,390 --> 01:39:14,320

they were a life experiment and they

2143

01:39:18,390 --> 01:39:16,400

scooped and made measurements of that

2144

01:39:20,629 --> 01:39:18,400

they that was pretty inconclusive in

2145

01:39:22,470 --> 01:39:20,639

fact most scientists believe that

2146

01:39:24,470 --> 01:39:22,480

that viking results

2147

01:39:28,229 --> 01:39:24,480

didn't indicate that there was life on

2148

01:39:31,350 --> 01:39:28,239

the surface but viking landed in modern

2149

01:39:32,870 --> 01:39:31,360

mars bathed in ultraviolet radiation and

2150

01:39:35,350 --> 01:39:32,880

cosmic rays

2151

01:39:38,390 --> 01:39:35,360

curiosity has gone to a place that's

2152

01:39:41,350 --> 01:39:38,400

been unmodified in three and a half or

2153

01:39:44,390 --> 01:39:41,360

so billion years it literally went to

2154

01:39:46,629 --> 01:39:44,400

the right place back in time and that

2155

01:39:48,229 --> 01:39:46,639

enabled us to really see what mars's

2156

01:39:50,390 --> 01:39:48,239

past was like

2157

01:39:51,669 --> 01:39:50,400

and that's what we want to do next find

2158

01:39:53,510 --> 01:39:51,679

that next

2159

01:39:55,189 --> 01:39:53,520

fabulous location

2160

01:39:57,270 --> 01:39:55,199

undisturbed

2161

01:39:59,189 --> 01:39:57,280

in its past where life could have

2162

01:40:00,709 --> 01:39:59,199

existed

2163

01:40:02,149 --> 01:40:00,719

let's take a quick question from social

2164

01:40:03,510 --> 01:40:02,159

media if we could

2165

01:40:05,590 --> 01:40:03,520

sure we have a question here from

2166

01:40:07,350 --> 01:40:05,600

twitter user sheldon c

2167

01:40:09,350 --> 01:40:07,360

has anything you found on mars in the

2168

01:40:12,229 --> 01:40:09,360

past year triggered plans for additional

2169

01:40:15,030 --> 01:40:12,239

questions research and exploration

2170

01:40:17,669 --> 01:40:15,040

yes indeed just about everything that we

2171

01:40:18,950 --> 01:40:17,679

find out we want to know more about for

2172

01:40:21,590 --> 01:40:18,960

instance

2173

01:40:23,910 --> 01:40:21,600

not to get too technical but we looked

2174

01:40:26,070 --> 01:40:23,920

at from the atmospheric instrument

2175

01:40:28,070 --> 01:40:26,080

ratios of argon there's different types

2176

01:40:31,270 --> 01:40:28,080

of argon one argon heavier than the

2177

01:40:34,470 --> 01:40:31,280

other argon doesn't react with anything

2178

01:40:36,550 --> 01:40:34,480

but it has a natural amount of each of

2179

01:40:39,109 --> 01:40:36,560

those elements throughout the solar

2180

01:40:41,109 --> 01:40:39,119

system and when we were at mars and we

2181

01:40:44,149 --> 01:40:41,119

made those measurements of argon we

2182

01:40:46,629 --> 01:40:44,159

found the lighter argon had left

2183

01:40:48,470 --> 01:40:46,639

mostly the heavy argon was there the

2184

01:40:51,189 --> 01:40:48,480

only way that could have happened is

2185

01:40:53,910 --> 01:40:51,199

that mars atmosphere was stripped away

2186

01:40:54,950 --> 01:40:53,920

it changed where did it go how did that

2187

01:40:57,750 --> 01:40:54,960

happen

2188

01:40:59,910 --> 01:40:57,760

so our next big mission maven which will

2189

01:41:01,189 --> 01:40:59,920

be launched in november is designed to

2190

01:41:03,270 --> 01:41:01,199

go to mars

2191

01:41:05,270 --> 01:41:03,280

be able to orbit and look at how the

2192

01:41:07,830 --> 01:41:05,280

solar wind interacts with a planet that

2193

01:41:09,750 --> 01:41:07,840

no longer has a magnetic field you know

2194

01:41:11,830 --> 01:41:09,760

mars lost its field

2195

01:41:13,270 --> 01:41:11,840

billions of years ago

2196

01:41:15,109 --> 01:41:13,280

and we want to know why that happened

2197

01:41:16,950 --> 01:41:15,119

but we want to see that process and

2198

01:41:19,189 --> 01:41:16,960

whether the solar wind actually did the

2199

01:41:20,629 --> 01:41:19,199

stripping or something else happen to

2200

01:41:22,390 --> 01:41:20,639

its atmosphere

2201

01:41:24,550 --> 01:41:22,400

so just each and every one of those

2202

01:41:27,189 --> 01:41:24,560

discoveries builds on the next set of

2203

01:41:29,270 --> 01:41:27,199

questions we want to answer

2204

01:41:31,669 --> 01:41:29,280

say show hands for for questions we

2205

01:41:39,910 --> 01:41:31,679

haven't gotten to yet

2206

01:41:45,669 --> 01:41:42,629

uh there's an mro image

2207

01:41:48,629 --> 01:41:45,679

a while back that showed what seemed to

2208

01:41:49,910 --> 01:41:48,639

be uh liquid water flowing seasonally on

2209

01:41:52,870 --> 01:41:49,920

mars there

2210

01:41:54,310 --> 01:41:52,880

any plans to get closer to things like

2211

01:41:59,270 --> 01:41:54,320

that

2212

01:42:02,470 --> 01:41:59,280

referring to we actually see fairly

2213

01:42:04,950 --> 01:42:02,480

often now because we know where to look

2214

01:42:06,629 --> 01:42:04,960

it they occur during the summer when

2215

01:42:08,709 --> 01:42:06,639

crater walls

2216

01:42:10,070 --> 01:42:08,719

are such that they get the maximum

2217

01:42:12,149 --> 01:42:10,080

sunlight

2218

01:42:16,149 --> 01:42:12,159

now what must be happening

2219

01:42:18,310 --> 01:42:16,159

is that sunlight is sublimating in other

2220

01:42:20,550 --> 01:42:18,320

words uh going through that process of

2221

01:42:21,669 --> 01:42:20,560

of solid to vapor

2222

01:42:24,310 --> 01:42:21,679

another uh

2223

01:42:26,550 --> 01:42:24,320

the aquifers that are plugged up

2224

01:42:28,470 --> 01:42:26,560

that releases what's inside these

2225

01:42:30,950 --> 01:42:28,480

aquifers which we believe

2226

01:42:32,870 --> 01:42:30,960

are brining water which flows down the

2227

01:42:35,669 --> 01:42:32,880

crater walls

2228

01:42:38,470 --> 01:42:35,679

you can't go anywhere on this planet and

2229

01:42:40,229 --> 01:42:38,480

grab a thimble full of water without

2230

01:42:41,270 --> 01:42:40,239

finding life

2231

01:42:43,990 --> 01:42:41,280

all right

2232

01:42:47,030 --> 01:42:44,000

so the fact that mars has trapped water

2233

01:42:49,910 --> 01:42:47,040

inside it still bodes well

2234

01:42:51,430 --> 01:42:49,920

for potentially finding life even

2235

01:42:53,910 --> 01:42:51,440

perhaps today

2236

01:42:56,149 --> 01:42:53,920

well the aquifers are pretty deep

2237

01:42:59,109 --> 01:42:56,159

we still have a lot to learn before we

2238

01:43:01,189 --> 01:42:59,119

know where to go we need to understand

2239

01:43:02,950 --> 01:43:01,199

how close they are to the surface and

2240

01:43:04,550 --> 01:43:02,960

where we might be able to investigate

2241

01:43:06,470 --> 01:43:04,560

those in the future

2242

01:43:08,310 --> 01:43:06,480

in the meantime as i mentioned after

2243

01:43:11,910 --> 01:43:08,320

maven will come

2244

01:43:14,310 --> 01:43:11,920

uh our our mars rover in 2020 and that

2245

01:43:16,709 --> 01:43:14,320

one is going to bore holes into rocks

2246

01:43:18,310 --> 01:43:16,719

and look back in the past and it's

2247

01:43:20,470 --> 01:43:18,320

really the past

2248

01:43:23,430 --> 01:43:20,480

that we have the greatest chance to find

2249

01:43:24,550 --> 01:43:23,440

out if mars was ever inhabited that

2250

01:43:26,229 --> 01:43:24,560

should leave

2251

01:43:29,109 --> 01:43:26,239

remnant material

2252

01:43:31,510 --> 01:43:29,119

you know organic carbon all the right

2253

01:43:33,430 --> 01:43:31,520

stuff and that's what we want to look at

2254

01:43:35,669 --> 01:43:33,440

next that will be our next step but the

2255

01:43:38,149 --> 01:43:35,679

briny water is really intriguing and we

2256

01:43:40,149 --> 01:43:38,159

do want to follow up on that someday hey

2257

01:43:41,350 --> 01:43:40,159

jim before before we uh we lose you

2258

01:43:42,550 --> 01:43:41,360

what's um what are the follow-on

2259

01:43:45,189 --> 01:43:42,560

missions that we should be looking for

2260

01:43:47,270 --> 01:43:45,199

here well the one we're launching in

2261

01:43:50,149 --> 01:43:47,280

november is maven

2262

01:43:53,109 --> 01:43:50,159

it is an orbiter and it's designed to be

2263

01:43:54,790 --> 01:43:53,119

able to look at how the ionosphere and

2264

01:43:57,030 --> 01:43:54,800

atmosphere of mars

2265

01:43:59,109 --> 01:43:57,040

interacts with that outgassing from the

2266

01:44:00,870 --> 01:43:59,119

sun called the solar wind

2267

01:44:03,030 --> 01:44:00,880

and we know that solar wind may be

2268

01:44:04,790 --> 01:44:03,040

stripping atmosphere away and we want to

2269

01:44:07,350 --> 01:44:04,800

see that process and we want to see what

2270

01:44:09,510 --> 01:44:07,360

it's losing and that will tell us a lot

2271

01:44:11,750 --> 01:44:09,520

about what's happened to mars

2272

01:44:14,070 --> 01:44:11,760

with respect to those processes over

2273

01:44:17,350 --> 01:44:14,080

millions and millions of years

2274

01:44:19,510 --> 01:44:17,360

our next nasa-led mission is indeed the

2275

01:44:22,550 --> 01:44:19,520

2020 rover

2276

01:44:25,270 --> 01:44:22,560

we'll launch it in 2020 it will land

2277

01:44:27,750 --> 01:44:25,280

about nine months later we will use the

2278

01:44:29,830 --> 01:44:27,760

scary sky crane as everyone has called

2279

01:44:32,149 --> 01:44:29,840

it in the past we'll relive that seven

2280

01:44:34,310 --> 01:44:32,159

minutes of terror i'm sure

2281

01:44:36,070 --> 01:44:34,320

but what we put down on the surface will

2282

01:44:38,390 --> 01:44:36,080

be a completely different set of

2283

01:44:40,310 --> 01:44:38,400

experiments and we'll be taking that

2284

01:44:42,870 --> 01:44:40,320

next step along the way

2285

01:44:43,910 --> 01:44:42,880

that allows humans to go to mars in the

2286

01:44:45,030 --> 01:44:43,920

future

2287

01:44:49,430 --> 01:44:45,040

let's give a big round of applause for

2288

01:44:49,440 --> 01:44:52,550

okay

2289

01:44:55,669 --> 01:44:53,590

so now we're going to talk about one of

2290

01:44:57,990 --> 01:44:55,679

my favorite subjects i'm sure many of

2291

01:45:00,310 --> 01:44:58,000

yours as well which is technology uh

2292

01:45:02,629 --> 01:45:00,320

research into space uh you know and the

2293

01:45:04,709 --> 01:45:02,639

things that nasa accomplishes inevitably

2294

01:45:06,390 --> 01:45:04,719

improves lives on earth as well you know

2295

01:45:08,709 --> 01:45:06,400

through the invention and innovation of

2296

01:45:10,550 --> 01:45:08,719

new technologies the journey to mars

2297

01:45:12,310 --> 01:45:10,560

it's an asteroid and mars for nasa is

2298

01:45:14,629 --> 01:45:12,320

not going to be any different our next

2299

01:45:15,910 --> 01:45:14,639

speaker directs cross-cutting technology

2300

01:45:18,229 --> 01:45:15,920

innovation and development for the

2301

01:45:20,390 --> 01:45:18,239

agency he is the acting director of the

2302

01:45:22,229 --> 01:45:20,400

strategic integration and analysis

2303

01:45:23,990 --> 01:45:22,239

office within the space technology

2304

01:45:30,070 --> 01:45:24,000

mission directorate here at nasa please

2305

01:45:35,189 --> 01:45:32,709

thank you uh good afternoon and i'm uh

2306

01:45:36,470 --> 01:45:35,199

very happy to be here um

2307

01:45:39,189 --> 01:45:36,480

what i'm going to talk about next slide

2308

01:45:41,910 --> 01:45:39,199

please our uh you know jim uh green just

2309

01:45:43,590 --> 01:45:41,920

laid out a nice uh overview of the mars

2310

01:45:45,590 --> 01:45:43,600

program from recent history and what

2311

01:45:47,510 --> 01:45:45,600

we're planning to do over the next 10

2312

01:45:50,149 --> 01:45:47,520

years say

2313

01:45:51,750 --> 01:45:50,159

to do robotic explorations but

2314

01:45:53,910 --> 01:45:51,760

what i'm here going to talk about is how

2315

01:45:56,390 --> 01:45:53,920

do we actually put boots on mars you

2316

01:45:58,470 --> 01:45:56,400

know one of the things that we as a

2317

01:46:00,950 --> 01:45:58,480

country want to do is explore

2318

01:46:02,790 --> 01:46:00,960

uh deeper into the space uh beyond low

2319

01:46:04,870 --> 01:46:02,800

earth orbit for humans and there are a

2320

01:46:07,430 --> 01:46:04,880

lot of challenges for that to occur uh

2321

01:46:09,669 --> 01:46:07,440

we've done a very good job of getting

2322

01:46:11,910 --> 01:46:09,679

astronauts into low earth orbit and the

2323

01:46:14,310 --> 01:46:11,920

vicinity of the earth moon system over

2324

01:46:16,149 --> 01:46:14,320

the years but to get further out into

2325

01:46:18,709 --> 01:46:16,159

deep space there are a number of areas

2326

01:46:20,709 --> 01:46:18,719

of technology we need to invest in

2327

01:46:21,830 --> 01:46:20,719

we've made a number of these investments

2328

01:46:23,990 --> 01:46:21,840

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

2329

01:46:27,189 --> 01:46:24,000

doing now but we need to make some

2330

01:46:29,590 --> 01:46:27,199

sustained uh investments for a decade or

2331

01:46:31,430 --> 01:46:29,600

more before we can get the reliability

2332

01:46:34,070 --> 01:46:31,440

and some of the capabilities we need to

2333

01:46:36,070 --> 01:46:34,080

send uh you know astronauts to the

2334

01:46:39,030 --> 01:46:36,080

surface of mars or deeper into the solar

2335

01:46:40,629 --> 01:46:39,040

system and what this chart kind of uh

2336

01:46:43,990 --> 01:46:40,639

shows here are

2337

01:46:46,149 --> 01:46:44,000

a number of the uh areas that we need to

2338

01:46:48,229 --> 01:46:46,159

make some investments and to to really

2339

01:46:51,350 --> 01:46:48,239

improve the capabilities and they uh

2340

01:46:53,590 --> 01:46:51,360

span many different areas for sending um

2341

01:46:55,910 --> 01:46:53,600

spacecraft and humans uh into deeper

2342

01:46:57,590 --> 01:46:55,920

space and one is better communications

2343

01:46:59,590 --> 01:46:57,600

you know right now we use radio

2344

01:47:01,669 --> 01:46:59,600

frequency communications to when we send

2345

01:47:03,910 --> 01:47:01,679

uh robotic spacecraft and even

2346

01:47:06,470 --> 01:47:03,920

astronauts into low earth orbit

2347

01:47:07,910 --> 01:47:06,480

but we want high band communications

2348

01:47:09,590 --> 01:47:07,920

when we send humans we're going to be

2349

01:47:10,470 --> 01:47:09,600

getting a lot more data if we want

2350

01:47:12,870 --> 01:47:10,480

really

2351

01:47:14,950 --> 01:47:12,880

video those types of things we want a

2352

01:47:16,709 --> 01:47:14,960

high-speed internet basically to be able

2353

01:47:18,070 --> 01:47:16,719

to bring those data back to here and so

2354

01:47:19,270 --> 01:47:18,080

some of the investments we're making on

2355

01:47:22,149 --> 01:47:19,280

is improving the communications

2356

01:47:25,590 --> 01:47:22,159

capability um life support obviously to

2357

01:47:28,149 --> 01:47:25,600

send humans uh outside the earth um we

2358

01:47:29,910 --> 01:47:28,159

require a life support system for them

2359

01:47:31,590 --> 01:47:29,920

we have uh

2360

01:47:34,390 --> 01:47:31,600

a lot of experiments going on at space

2361

01:47:36,870 --> 01:47:34,400

station to improve the reliability of a

2362

01:47:39,510 --> 01:47:36,880

environmental system for long duration

2363

01:47:41,189 --> 01:47:39,520

operation uh we need to test those out

2364

01:47:42,950 --> 01:47:41,199

make them much more higher reliability

2365

01:47:45,430 --> 01:47:42,960

so when we send astronauts to deeper

2366

01:47:47,189 --> 01:47:45,440

space or to mars on a mission we would

2367

01:47:50,229 --> 01:47:47,199

have systems that would provide

2368

01:47:52,629 --> 01:47:50,239

everything they need for daily uh living

2369

01:47:55,430 --> 01:47:52,639

from breathing to food

2370

01:47:57,830 --> 01:47:55,440

recycling uh waste so on and so forth um

2371

01:47:59,189 --> 01:47:57,840

because a mission to mars for humans is

2372

01:48:01,990 --> 01:47:59,199

going to take anywhere between two to

2373

01:48:04,950 --> 01:48:02,000

three years and so it's a long way to go

2374

01:48:06,550 --> 01:48:04,960

and a long time to come back and

2375

01:48:08,149 --> 01:48:06,560

we can't just go there and fix things

2376

01:48:10,070 --> 01:48:08,159

okay so we have to have systems that

2377

01:48:11,830 --> 01:48:10,080

will be highly reliable to be able to

2378

01:48:14,229 --> 01:48:11,840

take care of the astronauts

2379

01:48:17,430 --> 01:48:14,239

to not only live but the reason they're

2380

01:48:18,870 --> 01:48:17,440

going there for is to do this scientific

2381

01:48:21,189 --> 01:48:18,880

investigations that jim talked about

2382

01:48:22,629 --> 01:48:21,199

that we do robotic systems with but all

2383

01:48:24,870 --> 01:48:22,639

the other things that humans will bring

2384

01:48:28,229 --> 01:48:24,880

into that aspect to be able to figure

2385

01:48:29,830 --> 01:48:28,239

out uh what's near uh our so what's

2386

01:48:33,590 --> 01:48:29,840

within our solar system and near to our

2387

01:48:35,270 --> 01:48:33,600

planet uh and mars is really the next

2388

01:48:36,390 --> 01:48:35,280

big hurdle for sending humans deeper

2389

01:48:38,229 --> 01:48:36,400

into space

2390

01:48:40,870 --> 01:48:38,239

uh power generating storage they're

2391

01:48:42,790 --> 01:48:40,880

gonna need power to operate uh not only

2392

01:48:44,550 --> 01:48:42,800

uh what they need the astronauts but all

2393

01:48:46,550 --> 01:48:44,560

the equipment to do the analysis or

2394

01:48:48,709 --> 01:48:46,560

roving on mars and so on and so forth so

2395

01:48:50,470 --> 01:48:48,719

we have to find ways of generating power

2396

01:48:51,830 --> 01:48:50,480

and storing it so they can utilize it

2397

01:48:53,990 --> 01:48:51,840

for the extended period times that we

2398

01:48:57,270 --> 01:48:54,000

will be doing that

2399

01:48:58,830 --> 01:48:57,280

you see you know spirit and opportunity

2400

01:49:01,830 --> 01:48:58,840

curiosity rovers

2401

01:49:03,270 --> 01:49:01,840

there solar power and

2402

01:49:05,990 --> 01:49:03,280

curiosity used

2403

01:49:07,510 --> 01:49:06,000

a radioisotope generator to produce the

2404

01:49:09,270 --> 01:49:07,520

power we're going to need a lot more

2405

01:49:11,590 --> 01:49:09,280

power for when humans are on the surface

2406

01:49:13,510 --> 01:49:11,600

with a lot larger vehicles to be able to

2407

01:49:16,229 --> 01:49:13,520

operate those types of systems

2408

01:49:18,629 --> 01:49:16,239

logistics how do we pre-position large

2409

01:49:20,070 --> 01:49:18,639

things on the surface of mars

2410

01:49:22,390 --> 01:49:20,080

curiosity

2411

01:49:24,629 --> 01:49:22,400

allowed us to land one metric ton on the

2412

01:49:26,870 --> 01:49:24,639

surface of mars

2413

01:49:29,030 --> 01:49:26,880

to you that may sound like very big

2414

01:49:31,669 --> 01:49:29,040

right it is trust me because i spent my

2415

01:49:33,830 --> 01:49:31,679

previous uh i guess life here at nasa at

2416

01:49:36,709 --> 01:49:33,840

one of the space centers in uh

2417

01:49:38,070 --> 01:49:36,719

um hampton virginia nelson langley as an

2418

01:49:39,189 --> 01:49:38,080

entry descent and landing engineer i

2419

01:49:41,030 --> 01:49:39,199

helped land actually spirited

2420

01:49:42,390 --> 01:49:41,040

opportunity as well as phoenix

2421

01:49:44,790 --> 01:49:42,400

so i know the challenge of landing

2422

01:49:47,270 --> 01:49:44,800

something uh we barely are able to do a

2423

01:49:49,669 --> 01:49:47,280

metric ton now when we send humans

2424

01:49:51,350 --> 01:49:49,679

we're trying to land 40 metric tons so

2425

01:49:53,510 --> 01:49:51,360

we landed a car

2426

01:49:55,669 --> 01:49:53,520

what we need to do is a two-story house

2427

01:49:57,750 --> 01:49:55,679

when we send humans to mars how do we do

2428

01:49:59,430 --> 01:49:57,760

that we don't have a good method of

2429

01:50:00,629 --> 01:49:59,440

doing that right now

2430

01:50:02,550 --> 01:50:00,639

and so some of the investments we're

2431

01:50:03,830 --> 01:50:02,560

doing is based on

2432

01:50:05,669 --> 01:50:03,840

trying to do those types of things i'll

2433

01:50:08,229 --> 01:50:05,679

walk you through a few of those

2434

01:50:09,910 --> 01:50:08,239

navigation figuring out how precisely we

2435

01:50:12,709 --> 01:50:09,920

can get there

2436

01:50:14,870 --> 01:50:12,719

manufacturing in space and and for space

2437

01:50:16,709 --> 01:50:14,880

we would like to you know create what we

2438

01:50:19,109 --> 01:50:16,719

need when we get there so if we take

2439

01:50:21,030 --> 01:50:19,119

what you've heard of 3d printers we can

2440

01:50:22,550 --> 01:50:21,040

manufacture tools if we need to right on

2441

01:50:23,590 --> 01:50:22,560

the spot if we don't have something of

2442

01:50:25,189 --> 01:50:23,600

course if we

2443

01:50:27,030 --> 01:50:25,199

didn't bring something and we need

2444

01:50:29,030 --> 01:50:27,040

something like that to uh

2445

01:50:30,390 --> 01:50:29,040

repair something or we find something on

2446

01:50:31,990 --> 01:50:30,400

the surface of mars that hey we really

2447

01:50:33,430 --> 01:50:32,000

would like a tool like this if we didn't

2448

01:50:34,950 --> 01:50:33,440

bring it we wouldn't be able to do it so

2449

01:50:36,070 --> 01:50:34,960

a lot of investments in 3d printing

2450

01:50:38,390 --> 01:50:36,080

we're trying to take it to the next

2451
01:50:40,870 --> 01:50:38,400
level where we can actually manufacture

2452
01:50:42,870 --> 01:50:40,880
the material we need and then once we're

2453
01:50:44,390 --> 01:50:42,880
done with it recycle it so that that

2454
01:50:47,669 --> 01:50:44,400
material can be used to create other

2455
01:50:49,350 --> 01:50:47,679
things we're also doing food

2456
01:50:50,709 --> 01:50:49,360
creation with 3d printers to see if we

2457
01:50:52,550 --> 01:50:50,719
can

2458
01:50:54,229 --> 01:50:52,560
develop food that way for the astronauts

2459
01:50:57,750 --> 01:50:54,239
to eat as opposed to getting some stuff

2460
01:50:59,109 --> 01:50:57,760
that's freeze-dried for years upon um

2461
01:51:00,950 --> 01:50:59,119
prior to them departing so we're making

2462
01:51:03,350 --> 01:51:00,960
investments and trying to figuring out

2463
01:51:06,390 --> 01:51:03,360

how to do those things real time

2464

01:51:08,470 --> 01:51:06,400

propulsion is a big aspect of how do we

2465

01:51:10,070 --> 01:51:08,480

go deeper into space more efficiently so

2466

01:51:11,910 --> 01:51:10,080

we can take much more infrastructure

2467

01:51:14,229 --> 01:51:11,920

where we need to um

2468

01:51:15,590 --> 01:51:14,239

to this point we've only done one-way

2469

01:51:17,189 --> 01:51:15,600

missions to mars

2470

01:51:18,870 --> 01:51:17,199

when we send humans there obviously we

2471

01:51:21,030 --> 01:51:18,880

want to bring them back so that would be

2472

01:51:23,910 --> 01:51:21,040

a round-trip mission there's no gas

2473

01:51:25,350 --> 01:51:23,920

stations on the way okay and so or

2474

01:51:27,510 --> 01:51:25,360

convenience stores uh for example for

2475

01:51:29,830 --> 01:51:27,520

food either so we have to take all that

2476

01:51:31,990 --> 01:51:29,840

with us and so we need a propulsion

2477

01:51:34,310 --> 01:51:32,000

system that will be very efficient to

2478

01:51:35,990 --> 01:51:34,320

minimize all what we need to take in

2479

01:51:38,149 --> 01:51:36,000

particular the fuel to be able to get to

2480

01:51:39,669 --> 01:51:38,159

mars do what we need to do there and

2481

01:51:42,070 --> 01:51:39,679

come all the way back

2482

01:51:43,830 --> 01:51:42,080

entry descending landing as i mentioned

2483

01:51:46,629 --> 01:51:43,840

we have to land something about the size

2484

01:51:48,070 --> 01:51:46,639

of a house a two-story house on the

2485

01:51:49,830 --> 01:51:48,080

surface of mars and i'll talk about some

2486

01:51:51,750 --> 01:51:49,840

of those investments uh we talked about

2487

01:51:53,030 --> 01:51:51,760

the seven minutes of terror uh the

2488

01:51:54,709 --> 01:51:53,040

reason why it's seven minutes is you

2489

01:51:56,870 --> 01:51:54,719

fall very quickly

2490

01:51:58,149 --> 01:51:56,880

we have to land something very large in

2491

01:51:59,910 --> 01:51:58,159

the same amount of time and how can we

2492

01:52:01,350 --> 01:51:59,920

land something that big

2493

01:52:03,270 --> 01:52:01,360

and then radiation protection obviously

2494

01:52:04,629 --> 01:52:03,280

when we go into deeper space we want to

2495

01:52:06,390 --> 01:52:04,639

make sure that the astronauts are well

2496

01:52:08,310 --> 01:52:06,400

taken care of and so we're making

2497

01:52:09,669 --> 01:52:08,320

investments in those areas as well next

2498

01:52:11,589 --> 01:52:09,679

chart

2499

01:52:12,550 --> 01:52:11,599

so i talked about in space propulsion

2500

01:52:14,390 --> 01:52:12,560

that is a

2501
01:52:16,070 --> 01:52:14,400
large tall temple that we need to get

2502
01:52:17,669 --> 01:52:16,080
over and one of the areas we're

2503
01:52:18,950 --> 01:52:17,679
investing in right now is solar electric

2504
01:52:21,270 --> 01:52:18,960
propulsion

2505
01:52:23,510 --> 01:52:21,280
because it is a very fuel efficient way

2506
01:52:24,870 --> 01:52:23,520
of sending things into deeper space or

2507
01:52:26,070 --> 01:52:24,880
even around low earth orbit for that

2508
01:52:28,310 --> 01:52:26,080
matter and i'll talk about that in the

2509
01:52:29,990 --> 01:52:28,320
next chart um

2510
01:52:32,229 --> 01:52:30,000
so we are investing in propulsion

2511
01:52:34,709 --> 01:52:32,239
systems that we can use uh new

2512
01:52:38,149 --> 01:52:34,719
methodologies to be able to send large

2513
01:52:40,229 --> 01:52:38,159

equipment at a very efficient low fuel

2514

01:52:41,910 --> 01:52:40,239

usage uh we're making investments in the

2515

01:52:44,310 --> 01:52:41,920

solar array technology how how we can

2516

01:52:47,750 --> 01:52:44,320

use the sun's energy to produce the

2517

01:52:49,990 --> 01:52:47,760

power that we need to expel a propellant

2518

01:52:51,990 --> 01:52:50,000

like argon or xenon some other type of

2519

01:52:53,910 --> 01:52:52,000

thing through an engine and what you see

2520

01:52:55,830 --> 01:52:53,920

in this thruster development as well as

2521

01:52:57,510 --> 01:52:55,840

a high power processing unit where when

2522

01:52:59,030 --> 01:52:57,520

you have something very high power that

2523

01:53:01,350 --> 01:52:59,040

you're generating with those solar

2524

01:53:02,870 --> 01:53:01,360

arrays you need to condition it so that

2525

01:53:04,390 --> 01:53:02,880

you can utilize it for the various

2526

01:53:06,310 --> 01:53:04,400

systems be it for propulsion like an

2527

01:53:07,830 --> 01:53:06,320

engine or the onboard computers and

2528

01:53:10,070 --> 01:53:07,840

everything else we're making investments

2529

01:53:12,550 --> 01:53:10,080

in that and then obviously

2530

01:53:14,470 --> 01:53:12,560

uh the structure of where we put the

2531

01:53:17,270 --> 01:53:14,480

fuel in uh the structure of the

2532

01:53:19,750 --> 01:53:17,280

spacecraft of finding lightweight strong

2533

01:53:21,109 --> 01:53:19,760

materials that allow us to uh be able to

2534

01:53:22,790 --> 01:53:21,119

put a spacecraft together that's very

2535

01:53:25,030 --> 01:53:22,800

lightweight and use that

2536

01:53:26,870 --> 01:53:25,040

uh savings to put into the useful

2537

01:53:28,709 --> 01:53:26,880

aspects that the astronauts need and the

2538

01:53:30,550 --> 01:53:28,719

equipment we need to go to the deeper

2539

01:53:33,270 --> 01:53:30,560

space so we're making huge investments

2540

01:53:36,070 --> 01:53:33,280

in solar publishing right now

2541

01:53:38,229 --> 01:53:36,080

that will go towards uh testing out in

2542

01:53:39,189 --> 01:53:38,239

the asteroid

2543

01:53:41,350 --> 01:53:39,199

return

2544

01:53:43,589 --> 01:53:41,360

mission that you many of you heard about

2545

01:53:45,270 --> 01:53:43,599

as jim mentioned we did steps from a

2546

01:53:46,950 --> 01:53:45,280

small rover to kind of get our feet wet

2547

01:53:48,950 --> 01:53:46,960

figuring out how to do that on mars the

2548

01:53:50,470 --> 01:53:48,960

larger ones and then ones like you

2549

01:53:51,669 --> 01:53:50,480

see here with curiosity we're going to

2550

01:53:53,910 --> 01:53:51,679

take the same approach with many of

2551
01:53:55,589 --> 01:53:53,920
these systems is test them out with uh

2552
01:53:57,430 --> 01:53:55,599
for example this asteroid

2553
01:53:59,910 --> 01:53:57,440
retrieval mission of the propulsion

2554
01:54:02,149 --> 01:53:59,920
system um how we can we do autonomously

2555
01:54:03,189 --> 01:54:02,159
all these aspects of operating in space

2556
01:54:05,109 --> 01:54:03,199
when uh

2557
01:54:06,229 --> 01:54:05,119
uh at distances when humans aren't

2558
01:54:08,709 --> 01:54:06,239
nearby

2559
01:54:11,189 --> 01:54:08,719
and then also when we bring this

2560
01:54:13,270 --> 01:54:11,199
asteroid closer to us about how

2561
01:54:15,030 --> 01:54:13,280
astronauts will live and work in space

2562
01:54:17,189 --> 01:54:15,040
going and looking at this asteroid so

2563
01:54:19,350 --> 01:54:17,199

those types of investments is what will

2564

01:54:20,709 --> 01:54:19,360

allow us to do by working on this

2565

01:54:22,390 --> 01:54:20,719

asteroid retrieval mission and

2566

01:54:25,109 --> 01:54:22,400

propulsion system here would be one of

2567

01:54:27,030 --> 01:54:25,119

the major elements of that next slide

2568

01:54:29,510 --> 01:54:27,040

one of the aspects of solar teleco

2569

01:54:30,790 --> 01:54:29,520

propulsion which is scp

2570

01:54:32,629 --> 01:54:30,800

is you can do so many different things

2571

01:54:34,550 --> 01:54:32,639

with it and here's just a list of few of

2572

01:54:36,950 --> 01:54:34,560

them where in low earth orbit you can do

2573

01:54:39,030 --> 01:54:36,960

satellite servicing where if you want to

2574

01:54:41,109 --> 01:54:39,040

refuel a satellite or repair a satellite

2575

01:54:43,430 --> 01:54:41,119

you can use this a very efficient way of

2576

01:54:45,510 --> 01:54:43,440

getting to it repairing it moving on uh

2577

01:54:46,950 --> 01:54:45,520

delivering payload to higher orbits we

2578

01:54:49,030 --> 01:54:46,960

use a traditional rocket to get into a

2579

01:54:50,550 --> 01:54:49,040

lower orbit and use the solar propulsion

2580

01:54:52,470 --> 01:54:50,560

to boost it the rest of the way it's

2581

01:54:55,669 --> 01:54:52,480

much more cost effective and fuel

2582

01:54:58,870 --> 01:54:55,679

efficient than uh systems we have now

2583

01:55:01,270 --> 01:54:58,880

uh overall debris uh removal and and

2584

01:55:03,189 --> 01:55:01,280

moving uh so that we can get things out

2585

01:55:05,030 --> 01:55:03,199

of the way that the space junk uh it

2586

01:55:06,709 --> 01:55:05,040

will make those types of activities much

2587

01:55:08,790 --> 01:55:06,719

more cost effective

2588

01:55:10,629 --> 01:55:08,800

as well as other missions we want to do

2589

01:55:12,070 --> 01:55:10,639

uh in the solar system where it can send

2590

01:55:14,709 --> 01:55:12,080

things out further

2591

01:55:16,470 --> 01:55:14,719

in a much more cost effective manner

2592

01:55:18,790 --> 01:55:16,480

than traditional rockets that we have

2593

01:55:21,669 --> 01:55:18,800

today so it allows us to do a cross

2594

01:55:23,109 --> 01:55:21,679

cutting type of capability uh with this

2595

01:55:25,030 --> 01:55:23,119

type of investment

2596

01:55:26,870 --> 01:55:25,040

next slide

2597

01:55:29,030 --> 01:55:26,880

so i hear you know it's talked about the

2598

01:55:30,790 --> 01:55:29,040

mars the challenges of deep space but

2599

01:55:32,229 --> 01:55:30,800

here specifically going on mars

2600

01:55:34,070 --> 01:55:32,239

challenges i'm not sure if you can read

2601
01:55:35,430 --> 01:55:34,080
all the sl the wording on there so i'll

2602
01:55:36,870 --> 01:55:35,440
walk you through a few of them and the

2603
01:55:39,350 --> 01:55:36,880
charts will be available for you guys to

2604
01:55:40,870 --> 01:55:39,360
look on the website but surface power i

2605
01:55:42,629 --> 01:55:40,880
talked about that once you get to mars

2606
01:55:44,310 --> 01:55:42,639
what are you going to do

2607
01:55:45,990 --> 01:55:44,320
in terms of power that the astronauts

2608
01:55:47,669 --> 01:55:46,000
will leave and the equipment to be able

2609
01:55:48,870 --> 01:55:47,679
to do everything we need

2610
01:55:50,149 --> 01:55:48,880
life support

2611
01:55:51,990 --> 01:55:50,159
we're making investments and i'll talk

2612
01:55:55,030 --> 01:55:52,000
about a few of these when on the next

2613
01:55:56,629 --> 01:55:55,040

chart when we get there um operating uh

2614

01:55:58,149 --> 01:55:56,639

on the surface operations how do you go

2615

01:56:01,030 --> 01:55:58,159

about doing that with robots and things

2616

01:56:02,709 --> 01:56:01,040

to help the astronauts multitask in many

2617

01:56:04,070 --> 01:56:02,719

ways to be able to do that

2618

01:56:06,709 --> 01:56:04,080

um

2619

01:56:07,750 --> 01:56:06,719

mars resource utilization

2620

01:56:09,030 --> 01:56:07,760

and

2621

01:56:10,310 --> 01:56:09,040

ascent from surface you know as i

2622

01:56:11,669 --> 01:56:10,320

mentioned we've only done one-way

2623

01:56:13,510 --> 01:56:11,679

missions to this point

2624

01:56:15,990 --> 01:56:13,520

so if we send humans to the surface of

2625

01:56:17,669 --> 01:56:16,000

mars we want to launch them back up

2626
01:56:19,270 --> 01:56:17,679
and be able to come back and we want to

2627
01:56:20,629 --> 01:56:19,280
in essence live off the land to be able

2628
01:56:21,830 --> 01:56:20,639
to do that

2629
01:56:23,589 --> 01:56:21,840
entry to sun landing i talk about

2630
01:56:25,270 --> 01:56:23,599
communications and getting to mars in

2631
01:56:26,550 --> 01:56:25,280
terms of in-space propulsion are many of

2632
01:56:28,390 --> 01:56:26,560
the same challenges about going deep

2633
01:56:30,629 --> 01:56:28,400
space as going to mars as well next

2634
01:56:32,870 --> 01:56:30,639
slide

2635
01:56:35,350 --> 01:56:32,880
um this chart basically just takes some

2636
01:56:37,270 --> 01:56:35,360
of the solutions that we have into those

2637
01:56:39,430 --> 01:56:37,280
eight elements that i just talked about

2638
01:56:40,870 --> 01:56:39,440

um i will focus more on the next slide

2639

01:56:42,310 --> 01:56:40,880

but it just gives you a few of the areas

2640

01:56:45,430 --> 01:56:42,320

so we're talking about a surface power

2641

01:56:46,950 --> 01:56:45,440

of fuel cells and batteries as well as

2642

01:56:48,790 --> 01:56:46,960

in life support a closed-loop life

2643

01:56:50,550 --> 01:56:48,800

support system so we can recycle all the

2644

01:56:52,390 --> 01:56:50,560

material that's going on for the

2645

01:56:54,149 --> 01:56:52,400

astronauts and so the amount of water we

2646

01:56:55,750 --> 01:56:54,159

need to bring the oxygen we need to

2647

01:56:57,270 --> 01:56:55,760

bring will be minimized to be able to

2648

01:56:59,109 --> 01:56:57,280

reuse those so just a couple of those

2649

01:57:01,109 --> 01:56:59,119

elements that uh solutions that we're

2650

01:57:02,950 --> 01:57:01,119

talking about next slide

2651
01:57:05,270 --> 01:57:02,960
so let me talk about a few of the

2652
01:57:06,629 --> 01:57:05,280
elements that in our strnd space

2653
01:57:08,629 --> 01:57:06,639
technology mission director which stands

2654
01:57:10,229 --> 01:57:08,639
for the advancements we are making

2655
01:57:11,669 --> 01:57:10,239
you can see on the right hand side there

2656
01:57:13,270 --> 01:57:11,679
on my right

2657
01:57:15,669 --> 01:57:13,280
entry descended land there's a lot of

2658
01:57:17,990 --> 01:57:15,679
activities going on the reason being is

2659
01:57:19,589 --> 01:57:18,000
we don't know how to land 40 metric tons

2660
01:57:21,189 --> 01:57:19,599
and we're trying to figure out systems

2661
01:57:22,709 --> 01:57:21,199
to be able to do that and we're trying

2662
01:57:24,790 --> 01:57:22,719
to do many different types because we're

2663
01:57:26,790 --> 01:57:24,800

not going to know which one is going to

2664

01:57:28,629 --> 01:57:26,800

win out in terms of the best capability

2665

01:57:30,229 --> 01:57:28,639

but also when you land something going

2666

01:57:32,070 --> 01:57:30,239

13 000 miles per hour when you get to

2667

01:57:34,470 --> 01:57:32,080

mars you have to go through every flight

2668

01:57:35,910 --> 01:57:34,480

regime to get to the ground

2669

01:57:37,750 --> 01:57:35,920

while if you're in an airplane you go

2670

01:57:39,510 --> 01:57:37,760

all subsonic so you're only you know

2671

01:57:40,790 --> 01:57:39,520

remain in one flight regime you have to

2672

01:57:42,870 --> 01:57:40,800

have different systems and all these

2673

01:57:44,550 --> 01:57:42,880

different hyper uh flight regimes to be

2674

01:57:46,470 --> 01:57:44,560

able to land some uh these types of

2675

01:57:47,910 --> 01:57:46,480

things and so you need systems in all

2676
01:57:49,350 --> 01:57:47,920
those different areas and so we need to

2677
01:57:50,950 --> 01:57:49,360
make investments to figure out how best

2678
01:57:52,790 --> 01:57:50,960
to slow down in those different speed

2679
01:57:54,310 --> 01:57:52,800
regimes to be able to do that

2680
01:57:56,470 --> 01:57:54,320
we're making investments in life support

2681
01:57:58,550 --> 01:57:56,480
for closed loop

2682
01:57:59,910 --> 01:57:58,560
systems uh we're testing those out on

2683
01:58:01,990 --> 01:57:59,920
the ground right now and we will test

2684
01:58:03,189 --> 01:58:02,000
them on on the space station so that we

2685
01:58:04,709 --> 01:58:03,199
can demonstrate them that they are

2686
01:58:06,149 --> 01:58:04,719
working properly like we need to to get

2687
01:58:08,149 --> 01:58:06,159
the higher reliability to be able to

2688
01:58:09,109 --> 01:58:08,159

send humans deeper into uh

2689

01:58:11,030 --> 01:58:09,119

mars

2690

01:58:12,790 --> 01:58:11,040

go on to the next slide

2691

01:58:15,350 --> 01:58:12,800

here's a few more investments in terms

2692

01:58:17,350 --> 01:58:15,360

of mars resource utilization let me kind

2693

01:58:18,790 --> 01:58:17,360

of leave you with this um

2694

01:58:21,270 --> 01:58:18,800

uh thought wise

2695

01:58:22,790 --> 01:58:21,280

um you know i spent uh most of my career

2696

01:58:24,070 --> 01:58:22,800

at nasa langley and hampton virginia

2697

01:58:25,990 --> 01:58:24,080

just

2698

01:58:28,870 --> 01:58:26,000

south part of virginia

2699

01:58:31,189 --> 01:58:28,880

jamestown settlement is just a handful

2700

01:58:33,430 --> 01:58:31,199

of miles up the coast when the settlers

2701

01:58:34,790 --> 01:58:33,440

came here uh maybe settlers weren't the

2702

01:58:36,790 --> 01:58:34,800

right word but the explorers came here

2703

01:58:38,950 --> 01:58:36,800

long ago um they brought what they

2704

01:58:40,950 --> 01:58:38,960

needed to come to the new land

2705

01:58:42,550 --> 01:58:40,960

just for the transit and then they lift

2706

01:58:43,589 --> 01:58:42,560

off they lived off the land once they

2707

01:58:45,350 --> 01:58:43,599

got here

2708

01:58:46,950 --> 01:58:45,360

this is what we're trying to do with

2709

01:58:49,750 --> 01:58:46,960

human missions to mars because if we if

2710

01:58:52,149 --> 01:58:49,760

those uh ships that i had to bring

2711

01:58:53,910 --> 01:58:52,159

everything there with them to live in

2712

01:58:55,189 --> 01:58:53,920

the jamestown area

2713

01:58:57,109 --> 01:58:55,199

that endeavor would have been so

2714

01:58:59,430 --> 01:58:57,119

expensive and so large that would have

2715

01:59:01,669 --> 01:58:59,440

made it very prohibitive for anyone to

2716

01:59:03,270 --> 01:59:01,679

authorize to go you know and when we go

2717

01:59:04,950 --> 01:59:03,280

to mars we have to bring the air with us

2718

01:59:06,950 --> 01:59:04,960

too not just the water to drink or

2719

01:59:08,629 --> 01:59:06,960

something like that and so we want to do

2720

01:59:11,270 --> 01:59:08,639

something similar when we go with humans

2721

01:59:13,189 --> 01:59:11,280

to mars where we utilize the atmosphere

2722

01:59:15,030 --> 01:59:13,199

there on mars to be able to extract the

2723

01:59:16,950 --> 01:59:15,040

oxygen from so that we don't have to

2724

01:59:18,070 --> 01:59:16,960

bring all that oxygen with us so that we

2725

01:59:19,910 --> 01:59:18,080

can use that to breathe for the

2726

01:59:23,030 --> 01:59:19,920

astronauts we can make rocket fuel out

2727

01:59:24,390 --> 01:59:23,040

of it uh freeze it uh so that it's

2728

01:59:25,990 --> 01:59:24,400

liquid oxygen that we can use for

2729

01:59:26,950 --> 01:59:26,000

propellant so that we can launch off the

2730

01:59:29,430 --> 01:59:26,960

surface

2731

01:59:31,030 --> 01:59:29,440

so we want to do move and explore in a

2732

01:59:32,709 --> 01:59:31,040

very similar manner that we've done in

2733

01:59:34,229 --> 01:59:32,719

the past so that we can live off the

2734

01:59:36,709 --> 01:59:34,239

land to make all these missions very

2735

01:59:39,189 --> 01:59:36,719

cost effective and more efficient to be

2736

01:59:41,270 --> 01:59:39,199

able to uh conduct what we're trying to

2737

01:59:43,030 --> 01:59:41,280

do which is explore mars

2738

01:59:44,950 --> 01:59:43,040

in a much more

2739

01:59:46,950 --> 01:59:44,960

aggressive manner so that we can

2740

01:59:48,470 --> 01:59:46,960

actually really get a sense of are we

2741

01:59:50,470 --> 01:59:48,480

alone in the universe

2742

01:59:52,149 --> 01:59:50,480

um we're making many other investments

2743

01:59:53,589 --> 01:59:52,159

and those are just a few that i wanted

2744

01:59:55,510 --> 01:59:53,599

to talk about right now and i'll be

2745

02:00:00,870 --> 01:59:55,520

happy to take some questions

2746

02:00:05,430 --> 02:00:02,950

here in the uh here in the front lauren

2747

02:00:07,030 --> 02:00:05,440

i'm sorry in the go ahead

2748

02:00:09,350 --> 02:00:07,040

hey so you were talking about using

2749

02:00:11,430 --> 02:00:09,360

entry entry descent landing for uh human

2750

02:00:13,030 --> 02:00:11,440

exploration uh is there a physical

2751
02:00:13,830 --> 02:00:13,040
limitation to the amount of mass you can

2752
02:00:16,390 --> 02:00:13,840
bring

2753
02:00:18,550 --> 02:00:16,400
to another planet with that uh so

2754
02:00:21,030 --> 02:00:18,560
the only the only physical limitation is

2755
02:00:23,189 --> 02:00:21,040
what our systems would be capable of

2756
02:00:25,270 --> 02:00:23,199
either launching off the surface or once

2757
02:00:26,629 --> 02:00:25,280
we get there being able to slow down and

2758
02:00:28,070 --> 02:00:26,639
so it really comes down to what kind of

2759
02:00:30,229 --> 02:00:28,080
system do you design

2760
02:00:31,830 --> 02:00:30,239
um and right now we're limited to about

2761
02:00:33,750 --> 02:00:31,840
one metric ton because of the type of

2762
02:00:35,669 --> 02:00:33,760
technology we have to be able to land it

2763
02:00:37,910 --> 02:00:35,679

and so if we improve that technology

2764

02:00:39,510 --> 02:00:37,920

we'll be able to increase that uh

2765

02:00:41,430 --> 02:00:39,520

payload to be able to get to the surface

2766

02:00:42,629 --> 02:00:41,440

but there is no physics reason why we

2767

02:00:46,070 --> 02:00:42,639

can't land

2768

02:00:46,080 --> 02:00:50,390

here we go here to the front

2769

02:00:53,669 --> 02:00:52,229

what's the status of the laser

2770

02:00:55,109 --> 02:00:53,679

communication

2771

02:00:57,430 --> 02:00:55,119

technology that they're trying to use

2772

02:00:58,709 --> 02:00:57,440

from the space station

2773

02:01:01,589 --> 02:00:58,719

is it on

2774

02:01:03,990 --> 02:01:01,599

on track okay so so we have uh

2775

02:01:06,470 --> 02:01:04,000

a investment right now in our laser

2776

02:01:07,750 --> 02:01:06,480

communications relay demonstration where

2777

02:01:10,470 --> 02:01:07,760

in a few years we're going to

2778

02:01:12,310 --> 02:01:10,480

demonstrate uh optical communications

2779

02:01:14,470 --> 02:01:12,320

from orbit down to the ground to be able

2780

02:01:16,870 --> 02:01:14,480

to get much higher speeds of bandwidth

2781

02:01:20,229 --> 02:01:16,880

there it is progressing very well

2782

02:01:23,189 --> 02:01:20,239

um we hope to by 2017 launch it and be

2783

02:01:25,109 --> 02:01:23,199

able to do that demonstration um we also

2784

02:01:26,470 --> 02:01:25,119

are looking at deeper space uh

2785

02:01:28,390 --> 02:01:26,480

communications with that that's a low

2786

02:01:30,149 --> 02:01:28,400

earth orbit communication i shouldn't

2787

02:01:31,910 --> 02:01:30,159

say lower from geosynchronous orbit

2788

02:01:34,149 --> 02:01:31,920

orbit down to the ground so we'd be able

2789

02:01:35,589 --> 02:01:34,159

to do entire vicinity of the earth

2790

02:01:37,910 --> 02:01:35,599

we are trying to extend that to even

2791

02:01:39,750 --> 02:01:37,920

further deeper deep space activity and

2792

02:01:41,109 --> 02:01:39,760

so we have early investments in what it

2793

02:01:42,870 --> 02:01:41,119

would take to extend that capability

2794

02:01:44,390 --> 02:01:42,880

even further out in terms of into the

2795

02:01:46,709 --> 02:01:44,400

solar system and we're making those

2796

02:01:48,470 --> 02:01:46,719

assessments now as well and so hopefully

2797

02:01:51,109 --> 02:01:48,480

in a few years we will be able to get a

2798

02:01:53,189 --> 02:01:51,119

optical system for communications for

2799

02:01:55,030 --> 02:01:53,199

not only nasa's use but for commercial

2800

02:01:56,790 --> 02:01:55,040

use where all those communication

2801

02:01:58,950 --> 02:01:56,800

satellites in geostationary orbit will

2802

02:02:01,830 --> 02:01:58,960

be able to provide that as a service to

2803

02:02:05,189 --> 02:02:01,840

everyone on the ground for much more

2804

02:02:07,510 --> 02:02:05,199

bandwidth capability than we have now

2805

02:02:10,390 --> 02:02:07,520

let's go to social media for a question

2806

02:02:11,830 --> 02:02:10,400

sure so google plus user josh asks based

2807

02:02:13,669 --> 02:02:11,840

on what you have learned from curiosity

2808

02:02:15,510 --> 02:02:13,679

in the last year are there hardware

2809

02:02:17,030 --> 02:02:15,520

changes that you wish it possessed if

2810

02:02:21,350 --> 02:02:17,040

you had to rebuild curiosity from

2811

02:02:24,550 --> 02:02:22,950

how many hours does he have to talk

2812

02:02:26,629 --> 02:02:24,560

about no um

2813

02:02:28,470 --> 02:02:26,639

entry descent and landing is a very

2814

02:02:29,750 --> 02:02:28,480

difficult endeavor just

2815

02:02:31,270 --> 02:02:29,760

aspect

2816

02:02:32,790 --> 02:02:31,280

one of the things that we call mars the

2817

02:02:35,669 --> 02:02:32,800

goldilocks plan

2818

02:02:38,229 --> 02:02:35,679

the reason being there is uh not enough

2819

02:02:39,510 --> 02:02:38,239

atmosphere to really help you slow down

2820

02:02:41,430 --> 02:02:39,520

what you need like you do at earth when

2821

02:02:42,950 --> 02:02:41,440

you come down it slows us down so much

2822

02:02:45,430 --> 02:02:42,960

that it makes it much easier to land

2823

02:02:47,589 --> 02:02:45,440

heavier things on mars on earth other

2824

02:02:49,350 --> 02:02:47,599

than mars but there's just enough

2825

02:02:50,709 --> 02:02:49,360

atmosphere that you have to worry about

2826

02:02:52,070 --> 02:02:50,719

all these other things

2827

02:02:53,189 --> 02:02:52,080

uh if you land on the moon you don't

2828

02:02:54,550 --> 02:02:53,199

have to worry about thermal protection

2829

02:02:56,629 --> 02:02:54,560

systems because there's no atmosphere

2830

02:02:58,709 --> 02:02:56,639

you just propulsively come down slow and

2831

02:03:01,270 --> 02:02:58,719

land things and so

2832

02:03:03,990 --> 02:03:01,280

for curiosity um we're not going to make

2833

02:03:05,669 --> 02:03:04,000

any changes for the next uh landing that

2834

02:03:07,910 --> 02:03:05,679

uh the previous speaker talked about for

2835

02:03:11,270 --> 02:03:07,920

uh landing in 2020 the system worked

2836

02:03:13,270 --> 02:03:11,280

great uh we always have data that we get

2837

02:03:15,510 --> 02:03:13,280

back from there and we in fact had our

2838

02:03:17,109 --> 02:03:15,520

heat shield

2839

02:03:20,550 --> 02:03:17,119

on curiosity

2840

02:03:22,229 --> 02:03:20,560

instrumented with sensors that we are

2841

02:03:24,790 --> 02:03:22,239

downloading the data and analyzing it

2842

02:03:26,470 --> 02:03:24,800

right now on how everything went and

2843

02:03:28,470 --> 02:03:26,480

based on that we would make what we

2844

02:03:30,790 --> 02:03:28,480

think are best adjustments to that

2845

02:03:32,790 --> 02:03:30,800

before we do go on to the next landing

2846

02:03:36,310 --> 02:03:32,800

um but everything we saw it worked very

2847

02:03:38,149 --> 02:03:36,320

well um i think uh we in one thing is we

2848

02:03:40,229 --> 02:03:38,159

didn't use as much fuel that we had put

2849

02:03:41,589 --> 02:03:40,239

on the system and so we can look at

2850

02:03:43,430 --> 02:03:41,599

trades of hey

2851

02:03:45,109 --> 02:03:43,440

since it went so well we can minimize

2852

02:03:46,390 --> 02:03:45,119

the fuel we put on there and add more

2853

02:03:48,149 --> 02:03:46,400

payload capability to put more

2854

02:03:49,430 --> 02:03:48,159

instruments to figure out one on mars so

2855

02:03:50,870 --> 02:03:49,440

we would talk about those types of

2856

02:03:52,709 --> 02:03:50,880

changes but the system worked so well

2857

02:03:54,550 --> 02:03:52,719

that i don't believe we were going to do

2858

02:03:56,149 --> 02:03:54,560

any wholesale changes except some tweaks

2859

02:03:58,709 --> 02:03:56,159

here and there to just improve the

2860

02:04:00,790 --> 02:03:58,719

performance from where it was

2861

02:04:02,310 --> 02:04:00,800

okay please help me uh thank prost and

2862

02:04:06,229 --> 02:04:02,320

desai everyone thank you

2863

02:04:09,669 --> 02:04:07,510

all right

2864

02:04:10,870 --> 02:04:09,679

we are closing in on our conversation

2865

02:04:13,350 --> 02:04:10,880

with the international space station

2866

02:04:15,270 --> 02:04:13,360

about 20 minutes from now which means

2867

02:04:16,629 --> 02:04:15,280

i don't know it'll travel a quarter of

2868

02:04:19,270 --> 02:04:16,639

the earth

2869

02:04:21,270 --> 02:04:19,280

in in orbit between now and then uh here

2870

02:04:22,470 --> 02:04:21,280

to help us understand a little bit more

2871

02:04:25,430 --> 02:04:22,480

about some of the research and

2872

02:04:28,950 --> 02:04:25,440

technology that's uh taking place above

2873

02:04:30,629 --> 02:04:28,960

our heads some 220 miles moving 17 500

2874

02:04:32,070 --> 02:04:30,639

miles an hour and orbiting the earth

2875

02:04:33,510 --> 02:04:32,080

every 90 minutes in a national

2876
02:04:36,229 --> 02:04:33,520
laboratory that's helping solve some of

2877
02:04:38,149 --> 02:04:36,239
these challenges that you just heard

2878
02:04:39,750 --> 02:04:38,159
the our next speaker actually directs

2879
02:04:41,589 --> 02:04:39,760
the international space station program

2880
02:04:49,109 --> 02:04:41,599
here at nasa headquarters in washington

2881
02:04:53,750 --> 02:04:50,550
thank you trent

2882
02:04:55,750 --> 02:04:53,760
next slide please

2883
02:04:57,910 --> 02:04:55,760
well while one part of nasa has been

2884
02:04:59,350 --> 02:04:57,920
launching uh robots to mars and

2885
02:05:01,750 --> 02:04:59,360
exploring the service another part has

2886
02:05:03,910 --> 02:05:01,760
been launching people into space on to

2887
02:05:06,629 --> 02:05:03,920
the international space station

2888
02:05:08,149 --> 02:05:06,639

uh we are today and for several years

2889

02:05:11,109 --> 02:05:08,159

now and many years in the future are

2890

02:05:12,870 --> 02:05:11,119

working to send uh to do the research

2891

02:05:15,830 --> 02:05:12,880

and technology demonstrations onboard

2892

02:05:18,550 --> 02:05:15,840

space station to get humans to mars

2893

02:05:21,270 --> 02:05:18,560

uh next slide please

2894

02:05:23,030 --> 02:05:21,280

well mike ask where we are today as far

2895

02:05:25,830 --> 02:05:23,040

as getting people out into space well

2896

02:05:28,629 --> 02:05:25,840

today the space station is about 400

2897

02:05:30,870 --> 02:05:28,639

kilometers away from earth it only takes

2898

02:05:32,629 --> 02:05:30,880

about six hours to two days transit time

2899

02:05:35,189 --> 02:05:32,639

to go back and forth and the

2900

02:05:36,950 --> 02:05:35,199

communications is near real time

2901

02:05:38,629 --> 02:05:36,960

and we have crew exchanges that go back

2902

02:05:39,589 --> 02:05:38,639

and forth every six months for the

2903

02:05:41,589 --> 02:05:39,599

station

2904

02:05:43,669 --> 02:05:41,599

and we have atmospheric samples and crew

2905

02:05:45,669 --> 02:05:43,679

samples that come back to earth that can

2906

02:05:47,990 --> 02:05:45,679

be analyzed to detect if the crew is

2907

02:05:49,589 --> 02:05:48,000

healthy the atmosphere is healthy our

2908

02:05:51,510 --> 02:05:49,599

research samples and the things of that

2909

02:05:53,189 --> 02:05:51,520

nature and we have supplies and

2910

02:05:55,510 --> 02:05:53,199

logistics that get launched to space

2911

02:05:57,990 --> 02:05:55,520

station that way we can repair things

2912

02:06:02,229 --> 02:05:58,000

and get extra supplies up

2913

02:06:04,149 --> 02:06:02,239

we also have things as mundane as

2914

02:06:06,470 --> 02:06:04,159

removing trash from the space station

2915

02:06:08,470 --> 02:06:06,480

that burns up into the atmosphere

2916

02:06:10,870 --> 02:06:08,480

and most importantly is that we can

2917

02:06:13,189 --> 02:06:10,880

return the crew at practically any time

2918

02:06:16,629 --> 02:06:13,199

to come back in case of a on orbit

2919

02:06:18,709 --> 02:06:16,639

anomaly or a crew emergency

2920

02:06:20,790 --> 02:06:18,719

so what you're looking at today what we

2921

02:06:22,709 --> 02:06:20,800

have in space for our technology and our

2922

02:06:24,470 --> 02:06:22,719

knowledge we're basically just car

2923

02:06:26,310 --> 02:06:24,480

camping in space

2924

02:06:27,910 --> 02:06:26,320

if you've ever been car camping before

2925

02:06:30,550 --> 02:06:27,920

you take your car you build everything

2926

02:06:32,790 --> 02:06:30,560

up you need you that you need and you go

2927

02:06:35,430 --> 02:06:32,800

to a campsite if you get something you

2928

02:06:38,310 --> 02:06:35,440

go to walmart if you fall down and hurt

2929

02:06:40,149 --> 02:06:38,320

yourself you go to the hospital it's all

2930

02:06:42,310 --> 02:06:40,159

very convenient

2931

02:06:44,790 --> 02:06:42,320

next slide please

2932

02:06:47,430 --> 02:06:44,800

however mars isn't anything like that it

2933

02:06:50,470 --> 02:06:47,440

is completely different to go to mars we

2934

02:06:52,950 --> 02:06:50,480

have to build a capability and knowledge

2935

02:06:54,870 --> 02:06:52,960

to essentially live

2936

02:06:56,310 --> 02:06:54,880

on another earth to recreate a

2937

02:06:58,550 --> 02:06:56,320

capability what we just heard about

2938

02:07:00,390 --> 02:06:58,560

before in technology and the like to

2939

02:07:01,510 --> 02:07:00,400

provide our own atmospheres to remove

2940

02:07:03,830 --> 02:07:01,520

our trash

2941

02:07:06,229 --> 02:07:03,840

to be able to uh

2942

02:07:08,870 --> 02:07:06,239

keep the crew healthy all those things

2943

02:07:10,550 --> 02:07:08,880

has never been done before

2944

02:07:13,270 --> 02:07:10,560

neither here on earth has never been

2945

02:07:15,350 --> 02:07:13,280

recreated in an environment for such a

2946

02:07:18,550 --> 02:07:15,360

long period as mentioned before the

2947

02:07:20,870 --> 02:07:18,560

transit time to going to mars is one to

2948

02:07:22,390 --> 02:07:20,880

three years to go back and forth and our

2949

02:07:24,709 --> 02:07:22,400

communication

2950

02:07:27,350 --> 02:07:24,719

when we get to mars is up to 42 minutes

2951

02:07:29,030 --> 02:07:27,360

round trip there is no link between

2952

02:07:32,149 --> 02:07:29,040

earth and mars other than the

2953

02:07:34,550 --> 02:07:32,159

communications so on space station today

2954

02:07:36,550 --> 02:07:34,560

we are learning how to break all those

2955

02:07:39,030 --> 02:07:36,560

links not only just how to keep the crew

2956

02:07:41,189 --> 02:07:39,040

alive and healthy and productive but to

2957

02:07:43,990 --> 02:07:41,199

break all the logistics chain

2958

02:07:45,510 --> 02:07:44,000

break all the uh uh logistics the

2959

02:07:47,910 --> 02:07:45,520

delicious this has changed the

2960

02:07:50,149 --> 02:07:47,920

capability to return the crew safely

2961

02:07:53,350 --> 02:07:50,159

when we're going on to mars and once you

2962

02:07:55,030 --> 02:07:53,360

uh uh pass a certain point you can't get

2963

02:07:57,189 --> 02:07:55,040

back to earth

2964

02:07:59,270 --> 02:07:57,199

uh easily you have to actually go all

2965

02:08:01,270 --> 02:07:59,280

the way there and then come back and

2966

02:08:03,750 --> 02:08:01,280

then you've got orbital dynamics to take

2967

02:08:06,470 --> 02:08:03,760

to consider you can't come back just at

2968

02:08:07,990 --> 02:08:06,480

any time only predetermined times

2969

02:08:10,069 --> 02:08:08,000

so what are we doing on space station

2970

02:08:11,430 --> 02:08:10,079

today next slide

2971

02:08:13,189 --> 02:08:11,440

we're doing a whole lot of things and

2972

02:08:14,310 --> 02:08:13,199

i'm just going to only highlight a few

2973

02:08:17,750 --> 02:08:14,320

of them here

2974

02:08:19,910 --> 02:08:17,760

uh first is the duration today our crews

2975

02:08:22,790 --> 02:08:19,920

are rotated every six months on space

2976

02:08:24,709 --> 02:08:22,800

station and we have uh and our research

2977

02:08:25,830 --> 02:08:24,719

and our crew health is all based on six

2978

02:08:28,229 --> 02:08:25,840

months

2979

02:08:29,669 --> 02:08:28,239

uh time frame but to send people to mars

2980

02:08:31,750 --> 02:08:29,679

it's going to take at least a year to

2981

02:08:34,310 --> 02:08:31,760

get there and back so we need to be able

2982

02:08:35,750 --> 02:08:34,320

to understand the effects of weightless

2983

02:08:38,790 --> 02:08:35,760

weightlessness and radiation on the

2984

02:08:41,189 --> 02:08:38,800

human body so starting in 2015 we'll

2985

02:08:44,069 --> 02:08:41,199

start our first one-year crew increment

2986

02:08:47,350 --> 02:08:44,079

uh to understand the effects of bone

2987

02:08:50,550 --> 02:08:47,360

loss and muscle loss on on on longer

2988

02:08:51,910 --> 02:08:50,560

periods also in our on ocular vision uh

2989

02:08:54,709 --> 02:08:51,920

we've uh

2990

02:08:56,149 --> 02:08:54,719

had some uh issues with ocular vision on

2991

02:08:58,229 --> 02:08:56,159

on the astronauts that have been on

2992

02:08:59,830 --> 02:08:58,239

board space station for six months so

2993

02:09:03,750 --> 02:08:59,840

learning how to do that to keep the crew

2994

02:09:05,589 --> 02:09:03,760

healthy uh and to keep them uh

2995

02:09:07,030 --> 02:09:05,599

psychologically healthy and things of

2996

02:09:08,950 --> 02:09:07,040

that nature we're going to try that for

2997

02:09:10,709 --> 02:09:08,960

the first time in 2015 for a one-year

2998

02:09:13,109 --> 02:09:10,719

crew increment

2999

02:09:15,589 --> 02:09:13,119

starting on the right side

3000

02:09:17,350 --> 02:09:15,599

uh is is the second most important thing

3001
02:09:19,830 --> 02:09:17,360
is environmental control and monitoring

3002
02:09:22,310 --> 02:09:19,840
system today it takes a lot of

3003
02:09:24,709 --> 02:09:22,320
maintenance and a lot of crew time and

3004
02:09:26,149 --> 02:09:24,719
ground time to keep the environmental

3005
02:09:28,550 --> 02:09:26,159
control and life support system

3006
02:09:31,109 --> 02:09:28,560
functioning properly we are making

3007
02:09:33,750 --> 02:09:31,119
modifications to the system today to

3008
02:09:34,709 --> 02:09:33,760
increase its reliability and performance

3009
02:09:36,709 --> 02:09:34,719
and

3010
02:09:38,950 --> 02:09:36,719
in the next few years we hope to have

3011
02:09:40,950 --> 02:09:38,960
the marsh system for e for the

3012
02:09:43,270 --> 02:09:40,960
environmental control system on station

3013
02:09:46,629 --> 02:09:43,280

operating and it'll be that system that

3014

02:09:49,270 --> 02:09:46,639

we fly on on the iss that we take to the

3015

02:09:51,270 --> 02:09:49,280

mark to mars uh down from there is the

3016

02:09:53,030 --> 02:09:51,280

crew health and monitoring equipment and

3017

02:09:54,950 --> 02:09:53,040

a couple slides back you saw that we

3018

02:09:56,950 --> 02:09:54,960

have all the crew samples and air

3019

02:09:58,790 --> 02:09:56,960

samples that come back as far as you

3020

02:10:00,390 --> 02:09:58,800

know blood and urine and water and the

3021

02:10:02,390 --> 02:10:00,400

like to see if this if the crew's

3022

02:10:04,950 --> 02:10:02,400

healthy the systems are performing

3023

02:10:07,350 --> 02:10:04,960

correctly when we go to mars we can't do

3024

02:10:10,390 --> 02:10:07,360

that all that has to be characterized on

3025

02:10:13,990 --> 02:10:10,400

or on orbit with the crew uh uh

3026

02:10:16,069 --> 02:10:14,000

assistance and determining uh is is that

3027

02:10:17,910 --> 02:10:16,079

is all the performance parameters in its

3028

02:10:20,790 --> 02:10:17,920

normal ranges

3029

02:10:23,189 --> 02:10:20,800

uh going on to the uh top uh left on

3030

02:10:25,589 --> 02:10:23,199

your side is the exercise equipment

3031

02:10:28,550 --> 02:10:25,599

today our x is our size equipment is

3032

02:10:30,950 --> 02:10:28,560

large it has lots of moving parts it's

3033

02:10:33,750 --> 02:10:30,960

they're complex and they have take up a

3034

02:10:35,589 --> 02:10:33,760

lot of mass and space going to mars all

3035

02:10:38,229 --> 02:10:35,599

this will have to be a lot smaller than

3036

02:10:40,069 --> 02:10:38,239

it is today so we're making improvements

3037

02:10:41,430 --> 02:10:40,079

and flying additional equipment on board

3038

02:10:44,149 --> 02:10:41,440

the station

3039

02:10:46,870 --> 02:10:44,159

to ensure that the crew has

3040

02:10:48,149 --> 02:10:46,880

has functioning equipment uh to go to

3041

02:10:50,709 --> 02:10:48,159

mars with

3042

02:10:52,149 --> 02:10:50,719

we also have onboard water analyzers

3043

02:10:54,470 --> 02:10:52,159

again to

3044

02:10:55,669 --> 02:10:54,480

break the chain of bringing samples back

3045

02:10:56,390 --> 02:10:55,679

to earth

3046

02:10:58,709 --> 02:10:56,400

and

3047

02:11:00,390 --> 02:10:58,719

one of the other things not not the last

3048

02:11:02,470 --> 02:11:00,400

one but uh

3049

02:11:05,270 --> 02:11:02,480

one that we're working on right now is

3050

02:11:07,270 --> 02:11:05,280

the new exploration suit demonstration

3051

02:11:09,830 --> 02:11:07,280

uh today our suits

3052

02:11:12,950 --> 02:11:09,840

we have today on space station or 1980s

3053

02:11:15,990 --> 02:11:12,960

vintage uh uh technology so we're

3054

02:11:17,990 --> 02:11:16,000

working across nasa to

3055

02:11:20,390 --> 02:11:18,000

build a new suit and demonstrate it on

3056

02:11:21,750 --> 02:11:20,400

on space station so these are just some

3057

02:11:24,870 --> 02:11:21,760

of the things we're doing on space

3058

02:11:28,950 --> 02:11:24,880

station today to get us to mars and uh

3059

02:11:30,390 --> 02:11:28,960

with that i'd um open up the questions

3060

02:11:31,589 --> 02:11:30,400

thanks just want to remind the audience

3061

02:11:33,430 --> 02:11:31,599

that's joining us online that you can

3062

02:11:35,910 --> 02:11:33,440

ask questions of our speakers and pretty

3063

02:11:38,310 --> 02:11:35,920

soon here the crew using the hashtag ask

3064

02:11:39,589 --> 02:11:38,320

nasa on twitter and google plus i

3065

02:11:41,350 --> 02:11:39,599

actually want to take podium privilege

3066

02:11:43,030 --> 02:11:41,360

real quick sam and just ask a question

3067

02:11:46,550 --> 02:11:43,040

it's because jim showed this really

3068

02:11:49,750 --> 02:11:46,560

incredible picture um that uh that fan

3069

02:11:51,910 --> 02:11:49,760

made image of someone in a spacesuit

3070

02:11:53,350 --> 02:11:51,920

or at least a giant robot standing next

3071

02:11:55,430 --> 02:11:53,360

to curiosity i know there's some

3072

02:11:57,350 --> 02:11:55,440

robotics happening on station two and we

3073

02:11:59,109 --> 02:11:57,360

sometimes talk about how humans and

3074

02:12:00,550 --> 02:11:59,119

robots will be working together to

3075

02:12:02,149 --> 02:12:00,560

accomplish these things can you tell us

3076

02:12:03,350 --> 02:12:02,159

some of the some of the robotic

3077

02:12:05,189 --> 02:12:03,360

experiments that are happening on the

3078

02:12:07,589 --> 02:12:05,199

station right now and you know who the

3079

02:12:10,149 --> 02:12:07,599

robots are that are up there well

3080

02:12:11,750 --> 02:12:10,159

let's see how many robots do we have so

3081

02:12:13,669 --> 02:12:11,760

i'm familiar with at least three three

3082

02:12:16,310 --> 02:12:13,679

of the robots that are on station and

3083

02:12:18,149 --> 02:12:16,320

one that's on on its way uh

3084

02:12:20,790 --> 02:12:18,159

uh first two that have been there a long

3085

02:12:21,990 --> 02:12:20,800

time is the canadian arm and the

3086

02:12:24,069 --> 02:12:22,000

canadian

3087

02:12:27,030 --> 02:12:24,079

dexter manipulator system

3088

02:12:29,669 --> 02:12:27,040

these two large robots are basically

3089

02:12:32,550 --> 02:12:29,679

industrial robots and we've learned a

3090

02:12:34,550 --> 02:12:32,560

lot about assembling pieces in space how

3091

02:12:37,109 --> 02:12:34,560

to do ground control

3092

02:12:40,790 --> 02:12:37,119

uh how to do maintenance and things of

3093

02:12:43,430 --> 02:12:40,800

that nature we also have a a third robot

3094

02:12:45,910 --> 02:12:43,440

inside uh it's actually half of a robot

3095

02:12:47,750 --> 02:12:45,920

called robonaut doesn't have legs yet

3096

02:12:50,870 --> 02:12:47,760

and we're learning how on board space

3097

02:12:53,430 --> 02:12:50,880

station to integrate uh a robot

3098

02:12:56,149 --> 02:12:53,440

activities together in close proximity

3099

02:12:59,030 --> 02:12:56,159

to human activities uh so that's very

3100

02:13:00,870 --> 02:12:59,040

important to us as well and i think the

3101
02:13:02,629 --> 02:13:00,880
the fourth one that just was launched on

3102
02:13:04,390 --> 02:13:02,639
htv from japan

3103
02:13:06,870 --> 02:13:04,400
is uh i think the japanese are

3104
02:13:09,350 --> 02:13:06,880
characterizing it as a astronaut friend

3105
02:13:12,229 --> 02:13:09,360
robot it's a it's a small smaller robot

3106
02:13:14,069 --> 02:13:12,239
that that interacts verbally uh with

3107
02:13:15,510 --> 02:13:14,079
with a crew member and if i'm not

3108
02:13:17,109 --> 02:13:15,520
mistaken didn't we recently have some

3109
02:13:19,030 --> 02:13:17,119
crew members actually drive something

3110
02:13:20,470 --> 02:13:19,040
not too dissimilar and we also have

3111
02:13:23,109 --> 02:13:20,480
stations uh

3112
02:13:26,069 --> 02:13:23,119
remote controlled a robot and at the

3113
02:13:28,229 --> 02:13:26,079

ames research center uh that from the

3114

02:13:31,910 --> 02:13:28,239

crew on board the space station uh to

3115

02:13:33,990 --> 02:13:31,920

simulate actually uh driving uh space uh

3116

02:13:37,990 --> 02:13:34,000

uh robots from an orbiting spacecraft

3117

02:13:40,149 --> 02:13:38,000

all uh around the moon or actually mars

3118

02:13:41,189 --> 02:13:40,159

as well i i geeked out about that quite

3119

02:13:42,629 --> 02:13:41,199

honestly just growing up the remote

3120

02:13:44,229 --> 02:13:42,639

control car seeing astronaut drive

3121

02:13:45,350 --> 02:13:44,239

something on earth was free mind-blowing

3122

02:13:46,709 --> 02:13:45,360

we have any questions in the audience

3123

02:13:49,750 --> 02:13:46,719

right here

3124

02:13:52,229 --> 02:13:49,760

um yes these uh robots and robotics

3125

02:13:52,950 --> 02:13:52,239

they're so capable

3126

02:13:55,669 --> 02:13:52,960

and

3127

02:13:56,950 --> 02:13:55,679

what is the real advantage of having a

3128

02:14:00,310 --> 02:13:56,960

person

3129

02:14:02,069 --> 02:14:00,320

on these uh foreign

3130

02:14:03,669 --> 02:14:02,079

terrestrial places rather than just

3131

02:14:06,310 --> 02:14:03,679

sending so many

3132

02:14:08,950 --> 02:14:06,320

leaner easier to get to

3133

02:14:12,870 --> 02:14:08,960

more efficient robotics to the

3134

02:14:15,350 --> 02:14:12,880

mars and beyond uh if you compare what

3135

02:14:17,750 --> 02:14:15,360

it takes to plan and operate a robot

3136

02:14:20,390 --> 02:14:17,760

long distances like uh from earth to

3137

02:14:24,310 --> 02:14:20,400

mars and what a human can do

3138

02:14:27,350 --> 02:14:24,320

it takes a year or more for what a robot

3139

02:14:28,709 --> 02:14:27,360

can do that a person can do in a matter

3140

02:14:30,310 --> 02:14:28,719

of days

3141

02:14:33,510 --> 02:14:30,320

so one is

3142

02:14:35,430 --> 02:14:33,520

efficiency is that the crew member can

3143

02:14:37,589 --> 02:14:35,440

do things a lot quicker than a robot can

3144

02:14:39,430 --> 02:14:37,599

because it all has to be pre-planned and

3145

02:14:41,830 --> 02:14:39,440

with the communications lag between us

3146

02:14:44,149 --> 02:14:41,840

and and and mars that's a real that's a

3147

02:14:46,390 --> 02:14:44,159

real handicap uh the second biggest

3148

02:14:48,709 --> 02:14:46,400

thing and i think more important is you

3149

02:14:52,149 --> 02:14:48,719

have an intel an intelligent being

3150

02:14:55,030 --> 02:14:52,159

interpreting its environment a crew can

3151
02:14:57,510 --> 02:14:55,040
immediately pick up is this important is

3152
02:15:00,069 --> 02:14:57,520
that that's not important and if they're

3153
02:15:02,310 --> 02:15:00,079
trained as a geologist they can

3154
02:15:04,229 --> 02:15:02,320
pick up the right rock or not the right

3155
02:15:06,149 --> 02:15:04,239
rock so that's another advantage of

3156
02:15:08,470 --> 02:15:06,159
having the crew members and i think

3157
02:15:10,790 --> 02:15:08,480
thirdly there's a there's a societal

3158
02:15:13,270 --> 02:15:10,800
benefit as well to having uh people

3159
02:15:15,910 --> 02:15:13,280
involved uh in in

3160
02:15:17,990 --> 02:15:15,920
exploration i don't know anybody any

3161
02:15:20,709 --> 02:15:18,000
kids that want to grow up to be a robot

3162
02:15:22,229 --> 02:15:20,719
or to be a rocket

3163
02:15:24,069 --> 02:15:22,239

they all want to grow up to be an

3164

02:15:27,109 --> 02:15:24,079

astronaut or be a scientist or an

3165

02:15:29,430 --> 02:15:27,119

engineer uh no one's actually advocating

3166

02:15:34,149 --> 02:15:29,440

for people to be robot so

3167

02:15:36,709 --> 02:15:35,589

so let's take a question from social

3168

02:15:37,910 --> 02:15:36,719

media

3169

02:15:40,310 --> 02:15:37,920

sure we have a question here from

3170

02:15:42,709 --> 02:15:40,320

twitter user lucy whitehead there are

3171

02:15:45,669 --> 02:15:42,719

plans to put people on mars but is there

3172

02:15:47,270 --> 02:15:45,679

the possibility of people living on mars

3173

02:15:48,790 --> 02:15:47,280

yes i think at some point in time once

3174

02:15:49,830 --> 02:15:48,800

we've learned to travel there and come

3175

02:15:52,149 --> 02:15:49,840

back

3176

02:15:53,830 --> 02:15:52,159

and to be able to use the resources

3177

02:15:56,470 --> 02:15:53,840

on the martian surface i think it one

3178

02:15:58,390 --> 02:15:56,480

day will be possible

3179

02:16:04,629 --> 02:15:58,400

okay more questions in the audience

3180

02:16:10,149 --> 02:16:07,750

uh so uh if i'm not mistaken um this is

3181

02:16:12,390 --> 02:16:10,159

just as a backstory the faa

3182

02:16:14,550 --> 02:16:12,400

has ramped up

3183

02:16:15,910 --> 02:16:14,560

pilot requirements to do more manual

3184

02:16:18,229 --> 02:16:15,920

flying because there's been a lot of

3185

02:16:21,270 --> 02:16:18,239

concern about over automation too much

3186

02:16:23,030 --> 02:16:21,280

reliance on systems like that uh is

3187

02:16:25,189 --> 02:16:23,040

there any concern about that with nasa

3188

02:16:28,069 --> 02:16:25,199

that we would ever get too reliant on

3189

02:16:29,910 --> 02:16:28,079

these these automated systems like the

3190

02:16:31,510 --> 02:16:29,920

the unmanned flights that are headed to

3191

02:16:33,429 --> 02:16:31,520

the space station now

3192

02:16:37,270 --> 02:16:33,439

well uh there's just different aspects

3193

02:16:38,870 --> 02:16:37,280

of if you will crew control space flight

3194

02:16:40,469 --> 02:16:38,880

on the way up from the ground right

3195

02:16:42,790 --> 02:16:40,479

while riding on the rocket there's not a

3196

02:16:45,270 --> 02:16:42,800

lot the crew can actually do other than

3197

02:16:48,950 --> 02:16:45,280

get off the rocket if it's if something

3198

02:16:51,190 --> 02:16:48,960

goes wrong uh however in space um

3199

02:16:53,190 --> 02:16:51,200

there's always the capability for the

3200

02:16:54,950 --> 02:16:53,200

crew member to override any automated

3201

02:16:56,870 --> 02:16:54,960

system and the way we the way we've

3202

02:16:58,950 --> 02:16:56,880

designed uh systems in the past and the

3203

02:17:01,110 --> 02:16:58,960

way we're designing them in the future

3204

02:17:02,469 --> 02:17:01,120

there are some tasks that are better

3205

02:17:04,870 --> 02:17:02,479

left as the first

3206

02:17:07,270 --> 02:17:04,880

first level of control as automation

3207

02:17:08,950 --> 02:17:07,280

like automated rendezvous and docking uh

3208

02:17:11,030 --> 02:17:08,960

it's a lot more efficient that way but

3209

02:17:12,629 --> 02:17:11,040

the crew is always monitoring and able

3210

02:17:14,070 --> 02:17:12,639

to back out of the system in case

3211

02:17:15,990 --> 02:17:14,080

something something's wrong so i don't

3212

02:17:17,110 --> 02:17:16,000

think it's an either or it just comes

3213

02:17:19,270 --> 02:17:17,120

down to

3214

02:17:21,589 --> 02:17:19,280

what is more efficient and more uh

3215

02:17:24,150 --> 02:17:21,599

repeatable and reliable and but always

3216

02:17:26,309 --> 02:17:24,160

having the crew ability to back out of

3217

02:17:29,030 --> 02:17:26,319

it in in case the automated system uh

3218

02:17:30,070 --> 02:17:29,040

does not perform as expected

3219

02:17:32,070 --> 02:17:30,080

you know sam one of the one of the

3220

02:17:33,669 --> 02:17:32,080

things that our tv crew has is a really

3221

02:17:35,349 --> 02:17:33,679

nice image of the international space

3222

02:17:37,030 --> 02:17:35,359

station and i think some people sort of

3223

02:17:38,629 --> 02:17:37,040

forget you know we don't see it all all

3224

02:17:41,429 --> 02:17:38,639

that often in fact this almost looks

3225

02:17:43,509 --> 02:17:41,439

like a live view um what you know the

3226

02:17:45,669 --> 02:17:43,519

sheer size and scope of of what this

3227

02:17:47,990 --> 02:17:45,679

laboratory is maybe you can

3228

02:17:48,950 --> 02:17:48,000

get it's a live picture i'm being told

3229

02:17:50,709 --> 02:17:48,960

can you can you tell us what we're

3230

02:17:52,790 --> 02:17:50,719

looking at here as we get ready well

3231

02:17:56,389 --> 02:17:52,800

we're looking at uh the appendage that

3232

02:17:57,910 --> 02:17:56,399

you're seeing there sticking up is the

3233

02:18:00,790 --> 02:17:57,920

canadian arm

3234

02:18:03,110 --> 02:18:00,800

and you're seeing in in the forefront

3235

02:18:04,950 --> 02:18:03,120

the columbus module with its exposed

3236

02:18:07,190 --> 02:18:04,960

facilities

3237

02:18:08,950 --> 02:18:07,200

you also see the golden solar arrays

3238

02:18:11,990 --> 02:18:08,960

sticking through at the bottom

3239

02:18:12,950 --> 02:18:12,000

the u.s lab in the midsection there

3240

02:18:14,150 --> 02:18:12,960

and

3241

02:18:15,910 --> 02:18:14,160

of course the

3242

02:18:17,910 --> 02:18:15,920

earth above

3243

02:18:19,429 --> 02:18:17,920

the space station itself is as large as

3244

02:18:21,910 --> 02:18:19,439

a football field

3245

02:18:24,629 --> 02:18:21,920

and about a million pounds

3246

02:18:26,549 --> 02:18:24,639

it's it's unfortunate that uh the space

3247

02:18:27,910 --> 02:18:26,559

station never comes back and people

3248

02:18:30,709 --> 02:18:27,920

don't actually get a chance to see it

3249

02:18:33,830 --> 02:18:30,719

like the shuttle uh comes back the when

3250

02:18:36,309 --> 02:18:33,840

we have when we fly uh the soyuz or the

3251

02:18:38,870 --> 02:18:36,319

the the dragon vehicle it all comes back

3252

02:18:41,349 --> 02:18:38,880

so you can actually see it and and you

3253

02:18:43,429 --> 02:18:41,359

know hear it feel it touch it uh space

3254

02:18:45,750 --> 02:18:43,439

station you just can't you can see it

3255

02:18:48,389 --> 02:18:45,760

when it passes over

3256

02:18:50,150 --> 02:18:48,399

and do a little plug for spot to station

3257

02:18:51,509 --> 02:18:50,160

app to find space station wherever

3258

02:18:54,389 --> 02:18:51,519

you're located

3259

02:18:56,549 --> 02:18:54,399

but it's uh it's an amazing facility uh

3260

02:18:59,589 --> 02:18:56,559

it took many years and many flights to

3261

02:19:01,589 --> 02:18:59,599

get it assembled and

3262

02:19:03,910 --> 02:19:01,599

that's it and that's a good point uh

3263

02:19:05,910 --> 02:19:03,920

spot the station.nasa.gov is where you

3264

02:19:07,990 --> 02:19:05,920

can go to find out where the

3265

02:19:09,429 --> 02:19:08,000

international space station passes it's

3266

02:19:11,589 --> 02:19:09,439

i think it's pretty much the brightest

3267

02:19:13,750 --> 02:19:11,599

uh image or brightest um a point of

3268

02:19:15,910 --> 02:19:13,760

light in the sky when you see it except

3269

02:19:17,669 --> 02:19:15,920

for the sun and the moon yeah and it

3270

02:19:19,910 --> 02:19:17,679

moves quick but when you can catch it

3271

02:19:21,270 --> 02:19:19,920

it's uh it's very very cool to see let's

3272

02:19:22,950 --> 02:19:21,280

go back to social media for a question

3273

02:19:24,230 --> 02:19:22,960

then i'll check in the audience

3274

02:19:27,110 --> 02:19:24,240

sure we've got a question here from

3275

02:19:29,589 --> 02:19:27,120

twitter user genejm29

3276

02:19:31,429 --> 02:19:29,599

since current eva suits are 80s vintage

3277

02:19:32,870 --> 02:19:31,439

what is in development now and how long

3278

02:19:35,030 --> 02:19:32,880

will it be before those suits become

3279

02:19:37,110 --> 02:19:35,040

available well right now we have

3280

02:19:39,589 --> 02:19:37,120

technology development activities going

3281

02:19:42,230 --> 02:19:39,599

on uh today between uh

3282

02:19:43,509 --> 02:19:42,240

the human exploration uh and operations

3283

02:19:45,669 --> 02:19:43,519

mission directorate and the space

3284

02:19:47,270 --> 02:19:45,679

technology mission directorate uh to

3285

02:19:49,190 --> 02:19:47,280

develop the

3286

02:19:50,469 --> 02:19:49,200

newer generations

3287

02:19:54,150 --> 02:19:50,479

of of

3288

02:19:56,230 --> 02:19:54,160

scrubbers of the life support system

3289

02:19:58,630 --> 02:19:56,240

new materials for the suit

3290

02:20:01,670 --> 02:19:58,640

today our suit is a

3291

02:20:04,070 --> 02:20:01,680

a multi-part suit i would say and our

3292

02:20:06,389 --> 02:20:04,080

next generation suit will be more uh

3293

02:20:08,150 --> 02:20:06,399

like the or the russian orlan suit where

3294

02:20:10,630 --> 02:20:08,160

it's more or less one piece and the crew

3295

02:20:13,910 --> 02:20:10,640

steps in from the back uh there's a

3296

02:20:15,830 --> 02:20:13,920

picture of it right now uh the suit will

3297

02:20:17,830 --> 02:20:15,840

look similar for you know just by the

3298

02:20:20,389 --> 02:20:17,840

casual observer but the internal

3299

02:20:22,230 --> 02:20:20,399

functions uh will be completely uh

3300

02:20:25,990 --> 02:20:22,240

updated with newer technology and it'll

3301

02:20:31,030 --> 02:20:27,670

great questions in the audience

3302

02:20:33,190 --> 02:20:31,040

international space station in the front

3303

02:20:36,630 --> 02:20:33,200

does nasa have a view on private

3304

02:20:39,670 --> 02:20:36,640

initiatives like the mars one initiative

3305

02:20:43,389 --> 02:20:39,680

uh nasa is is support is supportive of

3306

02:20:45,750 --> 02:20:43,399

the private initiatives um the

3307

02:20:47,590 --> 02:20:45,760

inspiration mars i think that's that's

3308

02:20:50,790 --> 02:20:47,600

the the reason when that was that was

3309

02:20:53,190 --> 02:20:50,800

announced uh we're working uh with them

3310

02:20:55,349 --> 02:20:53,200

to understand what their mission is and

3311

02:20:57,030 --> 02:20:55,359

and what help they might need from nasa

3312

02:21:00,790 --> 02:20:57,040

so we're very supportive of such

3313

02:21:03,750 --> 02:21:00,800

missions i don't know if we're

3314

02:21:06,870 --> 02:21:03,760

actively promoting one-way

3315

02:21:08,870 --> 02:21:06,880

missions to mars as nasa's is in in the

3316

02:21:11,670 --> 02:21:08,880

two-way business

3317

02:21:13,590 --> 02:21:11,680

uh but we are we are very supportive of

3318

02:21:15,270 --> 02:21:13,600

private private initiatives

3319

02:21:16,950 --> 02:21:15,280

we like our astronauts to come home and

3320

02:21:18,550 --> 02:21:16,960

then the last couple of minutes uh that

3321

02:21:20,870 --> 02:21:18,560

we have with you uh sam could you

3322

02:21:22,389 --> 02:21:20,880

explain on that note on commercial space

3323

02:21:24,710 --> 02:21:22,399

kind of where we are in development of

3324

02:21:26,950 --> 02:21:24,720

the new spacecraft to take us astronauts

3325

02:21:29,030 --> 02:21:26,960

you know once again from u.s soil

3326

02:21:30,309 --> 02:21:29,040

i think they're there and people may be

3327

02:21:32,150 --> 02:21:30,319

familiar with a couple of the cargo

3328

02:21:33,590 --> 02:21:32,160

craft that came if you can talk a little

3329

02:21:34,950 --> 02:21:33,600

bit about how how the space station is

3330

02:21:36,630 --> 02:21:34,960

working on the commercial side in

3331

02:21:39,830 --> 02:21:36,640

american development well there's uh two

3332

02:21:42,630 --> 02:21:39,840

aspects to the commercial uh uh

3333

02:21:44,630 --> 02:21:42,640

involvement uh in in space on space

3334

02:21:48,070 --> 02:21:44,640

station and also i'd like to say just

3335

02:21:50,469 --> 02:21:48,080

more in private initiative in general uh

3336

02:21:51,830 --> 02:21:50,479

as you as many of you may know we have a

3337

02:21:54,870 --> 02:21:51,840

uh

3338

02:21:56,469 --> 02:21:54,880

commercial cargo providers spacex in

3339

02:21:58,950 --> 02:21:56,479

orbital to ride cargo to the space

3340

02:22:00,309 --> 02:21:58,960

station but we're also in development

3341

02:22:01,750 --> 02:22:00,319

with

3342

02:22:03,750 --> 02:22:01,760

other industry

3343

02:22:04,550 --> 02:22:03,760

partners to develop the commercial crew

3344

02:22:06,150 --> 02:22:04,560

car

3345

02:22:09,830 --> 02:22:06,160

capability

3346

02:22:11,750 --> 02:22:09,840

to space station uh with spacex boeing

3347

02:22:13,110 --> 02:22:11,760

and sierra nevada

3348

02:22:15,910 --> 02:22:13,120

but also that's only part of the

3349

02:22:19,190 --> 02:22:15,920

commercial initiative on board station

3350

02:22:21,990 --> 02:22:19,200

we are have a partnership with kasis

3351
02:22:23,750 --> 02:22:22,000
which is a the national lab developer

3352
02:22:25,510 --> 02:22:23,760
for for nasa

3353
02:22:27,910 --> 02:22:25,520
onboard the space station

3354
02:22:29,830 --> 02:22:27,920
cases is working with private industry

3355
02:22:32,389 --> 02:22:29,840
to utilize space station for things like

3356
02:22:35,670 --> 02:22:32,399
pharmaceutical research or

3357
02:22:38,389 --> 02:22:35,680
materials research like colloids

3358
02:22:40,630 --> 02:22:38,399
new medical devices and the like so our

3359
02:22:43,510 --> 02:22:40,640
commercial environment

3360
02:22:45,190 --> 02:22:43,520
involvement is uh is quite broad for on

3361
02:22:46,790 --> 02:22:45,200
on space station

3362
02:22:48,150 --> 02:22:46,800
so and real fast is there anything that

3363
02:22:49,590 --> 02:22:48,160

we just recently sent up to the crew

3364

02:22:51,510 --> 02:22:49,600

that you thought was particularly cool

3365

02:22:52,950 --> 02:22:51,520

any home packages or care package or

3366

02:22:55,750 --> 02:22:52,960

anything like that well you know fresh

3367

02:22:57,349 --> 02:22:55,760

food and ice cream is always good stuff

3368

02:22:58,630 --> 02:22:57,359

we'll see if we can get a question or

3369

02:23:00,309 --> 02:22:58,640

two about that

3370

02:23:07,590 --> 02:23:00,319

help me uh help me everyone please uh

3371

02:23:10,870 --> 02:23:08,870

very good

3372

02:23:13,349 --> 02:23:10,880

and we are now looking at a picture of

3373

02:23:14,790 --> 02:23:13,359

mission control in houston which helps

3374

02:23:17,030 --> 02:23:14,800

manage the international space station

3375

02:23:18,550 --> 02:23:17,040

program i understand just pause for a

3376

02:23:21,030 --> 02:23:18,560

second that we are very close to being

3377

02:23:23,190 --> 02:23:21,040

able to talk to chris cassidy and karen

3378

02:23:24,630 --> 02:23:23,200

nyberg who are the two american crew

3379

02:23:27,910 --> 02:23:24,640

members aboard the international space

3380

02:23:28,710 --> 02:23:27,920

station of the expedition 36 crew

3381

02:23:31,830 --> 02:23:28,720

so

3382

02:23:34,550 --> 02:23:31,840

let me start by asking uh station

3383

02:23:37,590 --> 02:23:34,560

station this is nasa headquarters how do

3384

02:23:41,349 --> 02:23:39,270

houston this is station we are ready for

3385

02:23:43,110 --> 02:23:41,359

the event thank you so much for joining

3386

02:23:46,790 --> 02:23:43,120

us chris and karen it's wonderful to see

3387

02:23:50,309 --> 02:23:48,710

so we're we're here in washington in the

3388

02:23:52,550 --> 02:23:50,319

nasa headquarters auditorium we've heard

3389

02:23:54,150 --> 02:23:52,560

a lot about curiosity's first year on

3390

02:23:55,510 --> 02:23:54,160

mars we've talked a lot about about new

3391

02:23:57,830 --> 02:23:55,520

technologies and some of the research

3392

02:23:59,910 --> 02:23:57,840

and technology you're doing on orbit

3393

02:24:02,389 --> 02:23:59,920

that'll help enable the path for humans

3394

02:24:03,910 --> 02:24:02,399

to mars here soon i want to jump into

3395

02:24:04,870 --> 02:24:03,920

questions here i know there will be many

3396

02:24:06,790 --> 02:24:04,880

for you

3397

02:24:09,270 --> 02:24:06,800

so if you'd stand by for the first and

3398

02:24:12,150 --> 02:24:09,280

we will get started

3399

02:24:13,030 --> 02:24:12,160

questions for the crew

3400

02:24:15,910 --> 02:24:13,040

okay

3401

02:24:40,230 --> 02:24:17,510

so

3402

02:24:45,030 --> 02:24:40,240

how are how are things going there day

3403

02:24:48,389 --> 02:24:46,950

okay sorry about that i think i stepped

3404

02:24:49,190 --> 02:24:48,399

on the the first part of the question

3405

02:24:52,870 --> 02:24:49,200

now

3406

02:24:55,270 --> 02:24:52,880

the day-to-day life is is really is

3407

02:24:57,190 --> 02:24:55,280

you know it's a nice pace it's a busy

3408

02:24:59,030 --> 02:24:57,200

day we wake up around uh

3409

02:25:00,790 --> 02:24:59,040

six have a conference with the ground at

3410

02:25:03,670 --> 02:25:00,800

7 30 and then work right straight

3411

02:25:05,349 --> 02:25:03,680

through until another conference at 7 30

3412

02:25:07,510 --> 02:25:05,359

at night but in that time is a break for

3413

02:25:09,429 --> 02:25:07,520

lunch and exercise which is is

3414

02:25:11,990 --> 02:25:09,439

critically important

3415

02:25:14,389 --> 02:25:12,000

for us uh for many reasons but it's a

3416

02:25:16,150 --> 02:25:14,399

it's a nice steady pace of the day and

3417

02:25:18,150 --> 02:25:16,160

at the end of the day it's really fun to

3418

02:25:20,309 --> 02:25:18,160

eat and join meals with the whole crew

3419

02:25:22,150 --> 02:25:20,319

and look out the window tell stories and

3420

02:25:24,070 --> 02:25:22,160

and and that sort of thing it's a it's a

3421

02:25:25,349 --> 02:25:24,080

nice day

3422

02:25:29,429 --> 02:25:25,359

question here in the front and then

3423

02:25:33,910 --> 02:25:32,389

with the issue they had with the

3424

02:25:36,790 --> 02:25:33,920

humidity or

3425

02:25:39,990 --> 02:25:36,800

water in the spacesuit in the few days

3426
02:25:41,510 --> 02:25:40,000
ago is that going to affect any other

3427
02:25:43,750 --> 02:25:41,520
extra

3428
02:25:49,190 --> 02:25:43,760
vehicular activities or

3429
02:25:52,630 --> 02:25:50,710
you know that's a that's a really good

3430
02:25:54,550 --> 02:25:52,640
question um right now we're we've been

3431
02:25:58,230 --> 02:25:54,560
doing some troubleshooting in the last

3432
02:26:01,030 --> 02:25:58,240
few weeks to really zone in on exactly

3433
02:26:02,550 --> 02:26:01,040
what part of of uh of the suit the

3434
02:26:06,230 --> 02:26:02,560
internal components of the suit which

3435
02:26:08,070 --> 02:26:06,240
part was it that failed and then to um

3436
02:26:10,070 --> 02:26:08,080
eliminate that as a problem that could

3437
02:26:12,070 --> 02:26:10,080
be a potential across the fleet of

3438
02:26:14,070 --> 02:26:12,080

spacesuits we we want to make sure that

3439

02:26:15,830 --> 02:26:14,080

it's isolated to that one suit before we

3440

02:26:17,670 --> 02:26:15,840

sign up for other people going out the

3441

02:26:20,469 --> 02:26:17,680

door because that's the most important

3442

02:26:22,950 --> 02:26:20,479

thing is making sure that every

3443

02:26:25,830 --> 02:26:22,960

dva team that we send out from now on is

3444

02:26:27,510 --> 02:26:25,840

is uh is for as a result of what we

3445

02:26:29,750 --> 02:26:27,520

learned from from these findings so

3446

02:26:32,230 --> 02:26:29,760

that's happening right now i don't think

3447

02:26:34,230 --> 02:26:32,240

that uh will there'll be any there's no

3448

02:26:36,630 --> 02:26:34,240

emergent need for a spacewalk right now

3449

02:26:39,270 --> 02:26:36,640

and until there is we'll make sure we'll

3450

02:26:41,910 --> 02:26:39,280

continue the steady pace of work to to

3451

02:26:43,670 --> 02:26:41,920

find out these things uh and then when

3452

02:26:45,750 --> 02:26:43,680

it's when the time is right and the team

3453

02:26:47,429 --> 02:26:45,760

is happy we'll be we'll be ready for

3454

02:26:50,469 --> 02:26:47,439

regular routine spacewalks again but

3455

02:26:50,479 --> 02:26:53,910

question in the front

3456

02:26:57,910 --> 02:26:55,590

hey

3457

02:26:59,750 --> 02:26:57,920

where were you guys a year ago on msl's

3458

02:27:07,590 --> 02:26:59,760

landing and how are you celebrating

3459

02:27:10,630 --> 02:27:09,110

gosh we're talking about it trying to

3460

02:27:12,630 --> 02:27:10,640

remember where we were and i i don't

3461

02:27:14,469 --> 02:27:12,640

remember i remember seeing it on the

3462

02:27:16,710 --> 02:27:14,479

news and i remember watching

3463

02:27:18,469 --> 02:27:16,720

and i remember just seeing what a huge

3464

02:27:20,309 --> 02:27:18,479

impact it was i remember seeing a

3465

02:27:21,990 --> 02:27:20,319

picture of times square

3466

02:27:24,950 --> 02:27:22,000

where just

3467

02:27:26,469 --> 02:27:24,960

thousands of people watching in awe um i

3468

02:27:28,790 --> 02:27:26,479

think i might have been in russia at the

3469

02:27:30,870 --> 02:27:28,800

time actually i honestly don't remember

3470

02:27:32,630 --> 02:27:30,880

the past year has been such a haze of

3471

02:27:35,429 --> 02:27:32,640

traveling back and forth for for

3472

02:27:37,429 --> 02:27:35,439

training but i do remember though

3473

02:27:39,670 --> 02:27:37,439

what an impact that it made on the

3474

02:27:42,150 --> 02:27:39,680

entire world and i i was actually quite

3475

02:27:43,670 --> 02:27:42,160

fascinated by that because and it

3476
02:27:45,429 --> 02:27:43,680
impressed me and i think it helped with

3477
02:27:48,630 --> 02:27:45,439
the way social media is working these

3478
02:27:51,510 --> 02:27:48,640
days and um and just what a fantastic

3479
02:27:53,990 --> 02:27:51,520
job that that the group at jpl did with

3480
02:27:56,469 --> 02:27:54,000
this um with this rover and and and

3481
02:28:00,389 --> 02:27:56,479
again just fascinated by what an impact

3482
02:28:03,429 --> 02:28:01,910
okay we'll take a question from social

3483
02:28:06,790 --> 02:28:03,439
media

3484
02:28:08,070 --> 02:28:06,800
sure twitter user micah winston asks

3485
02:28:09,750 --> 02:28:08,080
what would you say is the most

3486
02:28:15,990 --> 02:28:09,760
interesting experiment being done on the

3487
02:28:18,950 --> 02:28:17,429
it's hard to hone in on the most

3488
02:28:21,429 --> 02:28:18,960

interesting because there are there's

3489

02:28:22,790 --> 02:28:21,439

such a breadth of of different topics

3490

02:28:24,870 --> 02:28:22,800

that we're studying

3491

02:28:26,710 --> 02:28:24,880

uh some of the those that i think we

3492

02:28:28,630 --> 02:28:26,720

find the most interesting are the ones

3493

02:28:30,550 --> 02:28:28,640

that they're doing on the human body and

3494

02:28:32,150 --> 02:28:30,560

you know partly because because we're

3495

02:28:33,510 --> 02:28:32,160

the actual subjects for them and so

3496

02:28:36,550 --> 02:28:33,520

we're intimately involved in the

3497

02:28:38,150 --> 02:28:36,560

experiments but also also in the regard

3498

02:28:39,990 --> 02:28:38,160

that it's something that's very

3499

02:28:42,309 --> 02:28:40,000

important if we're going to be traveling

3500

02:28:44,309 --> 02:28:42,319

farther away from low earth orbit it's

3501

02:28:46,150 --> 02:28:44,319

um obviously going to be a very long

3502

02:28:49,110 --> 02:28:46,160

trip and what happens to our bodies not

3503

02:28:51,670 --> 02:28:49,120

just how they change in

3504

02:28:53,349 --> 02:28:51,680

the lack of gravity but to be sure that

3505

02:28:55,590 --> 02:28:53,359

we're going to be in shape to do work

3506

02:28:57,830 --> 02:28:55,600

when we get wherever we're going if we

3507

02:28:59,590 --> 02:28:57,840

make a trip to mars you know there will

3508

02:29:02,070 --> 02:28:59,600

be some gravity when we get there and if

3509

02:29:05,270 --> 02:29:02,080

we just let our bodies adapt to what a

3510

02:29:07,030 --> 02:29:05,280

zero gravity environment is then we will

3511

02:29:09,429 --> 02:29:07,040

be pretty much useless when we get there

3512

02:29:10,790 --> 02:29:09,439

unable to stand unable to walk unable to

3513

02:29:13,429 --> 02:29:10,800

to you know our muscles will have

3514

02:29:15,510 --> 02:29:13,439

degraded our bones will have degraded so

3515

02:29:17,910 --> 02:29:15,520

so i think some of the best

3516

02:29:19,429 --> 02:29:17,920

the most interesting in that regard is

3517

02:29:22,469 --> 02:29:19,439

is the work that we're doing on what's

3518

02:29:23,990 --> 02:29:22,479

happening to the human body

3519

02:29:26,309 --> 02:29:24,000

sure we have another question here from

3520

02:29:35,750 --> 02:29:26,319

twitter from chris connors what is your

3521

02:29:40,710 --> 02:29:38,790

well let's see there's uh

3522

02:29:42,950 --> 02:29:40,720

the sort of silly answer

3523

02:29:45,830 --> 02:29:42,960

is we have some when when something

3524

02:29:48,309 --> 02:29:45,840

needs to be stored up in the in the jlp

3525

02:29:50,150 --> 02:29:48,319

the japanese logistics area

3526

02:29:53,270 --> 02:29:50,160

and if we're in node one that's about

3527

02:29:56,389 --> 02:29:53,280

as far as you can go in a translation so

3528

02:29:58,070 --> 02:29:56,399

it's really fun to uh to go flying in a

3529

02:30:00,070 --> 02:29:58,080

controlled way but flying around the

3530

02:30:02,150 --> 02:30:00,080

corners to make that storage happen

3531

02:30:05,110 --> 02:30:02,160

that's a sort of a silly answer to a fun

3532

02:30:07,349 --> 02:30:05,120

thing but uh on a more work related

3533

02:30:09,830 --> 02:30:07,359

basis i i find it rewarding to fix

3534

02:30:11,910 --> 02:30:09,840

things and just like in your house

3535

02:30:13,670 --> 02:30:11,920

things break up here or or they need

3536

02:30:16,389 --> 02:30:13,680

maintenance and attention and it's

3537

02:30:18,870 --> 02:30:16,399

really rewarding when the ground team

3538

02:30:21,750 --> 02:30:18,880

puts together a procedure and we

3539

02:30:24,469 --> 02:30:21,760

work that procedure and and as a team we

3540

02:30:25,910 --> 02:30:24,479

repair a broken pump or a broken

3541

02:30:27,429 --> 02:30:25,920

fan or something like that i think

3542

02:30:34,790 --> 02:30:27,439

that's really rewarding and find that

3543

02:30:39,190 --> 02:30:37,110

um i saw karen post a picture of a

3544

02:30:40,870 --> 02:30:39,200

constellation a few weeks ago and i'm

3545

02:30:43,270 --> 02:30:40,880

just wondering compared to here on earth

3546

02:30:52,309 --> 02:30:43,280

how does how do the stars and

3547

02:30:55,830 --> 02:30:53,750

all the external

3548

02:30:57,030 --> 02:30:55,840

are off and then all the lights we have

3549

02:30:59,030 --> 02:30:57,040

inside

3550

02:31:01,110 --> 02:30:59,040

the node 3 area where our cupola is

3551
02:31:04,469 --> 02:31:01,120
where we look and your eyes start to

3552
02:31:06,950 --> 02:31:04,479
adjust it's amazing and i i remember on

3553
02:31:08,950 --> 02:31:06,960
our on my first shuttle flight when we

3554
02:31:14,309 --> 02:31:08,960
um we turned off all the lights when we

3555
02:31:17,510 --> 02:31:15,750
without going looking through the

3556
02:31:20,150 --> 02:31:17,520
atmosphere you don't see the same

3557
02:31:23,349 --> 02:31:20,160
twinkle that you do of the stars they're

3558
02:31:25,429 --> 02:31:23,359
very solid and very very bright and you

3559
02:31:27,030 --> 02:31:25,439
could also very easily pick out the

3560
02:31:29,510 --> 02:31:27,040
milky way

3561
02:31:31,270 --> 02:31:29,520
um and it just you start to see contrast

3562
02:31:36,630 --> 02:31:31,280
in the in the dark sky

3563
02:31:40,790 --> 02:31:37,990

um

3564

02:31:48,469 --> 02:31:40,800

now that you've left earth how do you

3565

02:31:52,230 --> 02:31:49,830

you know

3566

02:31:53,270 --> 02:31:52,240

that's a fun thing to think about

3567

02:31:57,750 --> 02:31:53,280

and

3568

02:32:00,389 --> 02:31:57,760

i like to think of myself as a um a

3569

02:32:02,150 --> 02:32:00,399

little element on on a mapping program

3570

02:32:04,710 --> 02:32:02,160

google earth or something and zoom out

3571

02:32:06,630 --> 02:32:04,720

from whatever area i'm looking at and up

3572

02:32:08,630 --> 02:32:06,640

to the perspective that i'm looking at

3573

02:32:11,030 --> 02:32:08,640

from the space station and

3574

02:32:12,710 --> 02:32:11,040

that's a fun mental exercise to do

3575

02:32:14,309 --> 02:32:12,720

that's just the visual aspect but i

3576

02:32:16,550 --> 02:32:14,319

think your question is probably deeper

3577

02:32:19,110 --> 02:32:16,560

than that talking about how do i

3578

02:32:21,990 --> 02:32:19,120

personally think about the planet and

3579

02:32:23,270 --> 02:32:22,000

what what strikes me is its beautiful

3580

02:32:26,309 --> 02:32:23,280

simplicity

3581

02:32:29,670 --> 02:32:26,319

and it's our own spaceship for all of us

3582

02:32:32,389 --> 02:32:29,680

and that we as a as a whole mankind need

3583

02:32:34,630 --> 02:32:32,399

to take care of that spaceship and

3584

02:32:36,630 --> 02:32:34,640

that's what being up here has really

3585

02:32:38,630 --> 02:32:36,640

given me the perspective on the

3586

02:32:40,309 --> 02:32:38,640

importance of taking care of our planet

3587

02:32:42,309 --> 02:32:40,319

earth

3588

02:32:43,590 --> 02:32:42,319

i see a young blue suit astronaut in

3589

02:32:45,830 --> 02:32:43,600

training in the audience who has a

3590

02:32:47,750 --> 02:32:45,840

question for you too

3591

02:32:51,270 --> 02:32:47,760

why do you guys live in the

3592

02:32:52,870 --> 02:32:51,280

international space station

3593

02:33:00,790 --> 02:32:52,880

why do you live in the international

3594

02:33:03,910 --> 02:33:02,950

well one of the main things that we want

3595

02:33:05,670 --> 02:33:03,920

to do

3596

02:33:09,190 --> 02:33:05,680

here at the international space station

3597

02:33:11,910 --> 02:33:09,200

as you can see we have no gravity

3598

02:33:13,990 --> 02:33:11,920

i'm going to lose myself

3599

02:33:16,150 --> 02:33:14,000

and there are a lot of things we can

3600

02:33:17,990 --> 02:33:16,160

study without gravity when you're on

3601
02:33:20,070 --> 02:33:18,000
earth you drop something and it falls

3602
02:33:22,150 --> 02:33:20,080
and it affects absolutely everything

3603
02:33:26,150 --> 02:33:22,160
when gravity pulls on it and so what we

3604
02:33:28,630 --> 02:33:26,160
can do here is study how liquids um and

3605
02:33:30,389 --> 02:33:28,640
various things work and what they what

3606
02:33:32,150 --> 02:33:30,399
they want to do on their own without

3607
02:33:34,950 --> 02:33:32,160
that pull of gravity and that's very

3608
02:33:37,030 --> 02:33:34,960
important for helping solve some of the

3609
02:33:39,270 --> 02:33:37,040
questions that scientists have about how

3610
02:33:41,030 --> 02:33:39,280
things work on the earth and it also is

3611
02:33:43,110 --> 02:33:41,040
very important for us to answer some of

3612
02:33:45,030 --> 02:33:43,120
the questions of how we can travel even

3613
02:33:48,150 --> 02:33:45,040

further than the international space

3614

02:33:52,630 --> 02:33:48,160

station and explore just like it's our

3615

02:33:56,710 --> 02:33:55,030

from twitter user leah crane can you see

3616

02:34:05,429 --> 02:33:56,720

meteors burning up in the atmosphere

3617

02:34:08,870 --> 02:34:07,510

actually yes i um i haven't seen one

3618

02:34:11,750 --> 02:34:08,880

since i've been up here in the past

3619

02:34:13,270 --> 02:34:11,760

couple months but i i do remember on on

3620

02:34:14,950 --> 02:34:13,280

my shuttle flight

3621

02:34:16,870 --> 02:34:14,960

perhaps it was that time that period of

3622

02:34:18,710 --> 02:34:16,880

time when we were all in the flight deck

3623

02:34:21,830 --> 02:34:18,720

looking out the windows that we could

3624

02:34:30,710 --> 02:34:21,840

see shooting stars below us

3625

02:34:36,309 --> 02:34:33,349

good hi what are some challenges to

3626

02:34:42,070 --> 02:34:36,319

everyday life um in zero gravity

3627

02:34:47,349 --> 02:34:44,309

well like karen was just talking about

3628

02:34:49,110 --> 02:34:47,359

gravity the absence of it can be a

3629

02:34:50,710 --> 02:34:49,120

challenge it can also be very helpful

3630

02:34:53,190 --> 02:34:50,720

when we're working obviously with large

3631

02:34:54,870 --> 02:34:53,200

mass things it's nice not to have that

3632

02:34:57,510 --> 02:34:54,880

uh gravity pull

3633

02:34:59,030 --> 02:34:57,520

but with smaller things it's actually

3634

02:35:00,950 --> 02:34:59,040

pretty inconvenient if you're taking

3635

02:35:01,830 --> 02:35:00,960

apart something with screws or small

3636

02:35:04,070 --> 02:35:01,840

parts

3637

02:35:05,349 --> 02:35:04,080

what do you do with all those items and

3638

02:35:07,830 --> 02:35:05,359

uh we use

3639

02:35:10,309 --> 02:35:07,840

great tape for instance and and put

3640

02:35:12,070 --> 02:35:10,319

stick things to that or we'll put

3641

02:35:13,830 --> 02:35:12,080

if it's a larger item we'll put it up

3642

02:35:15,270 --> 02:35:13,840

against the inlet of a fan and it'll

3643

02:35:17,190 --> 02:35:15,280

hold it in place

3644

02:35:20,230 --> 02:35:17,200

those kind of things are our everyday

3645

02:35:22,550 --> 02:35:20,240

challenges that that we face as we as we

3646

02:35:25,349 --> 02:35:22,560

work up here and uh and then the

3647

02:35:27,429 --> 02:35:25,359

challenges to ourselves is if we did not

3648

02:35:29,429 --> 02:35:27,439

do any exercise i'm sure you've heard

3649

02:35:31,030 --> 02:35:29,439

about this um our bones would just

3650

02:35:33,349 --> 02:35:31,040

atrophy and they would think ah they

3651

02:35:36,309 --> 02:35:33,359

don't i don't need to work so i can i

3652

02:35:38,870 --> 02:35:36,319

can quit doing my bone thing here and uh

3653

02:35:41,030 --> 02:35:38,880

and our job is to work consistently work

3654

02:35:42,550 --> 02:35:41,040

those bones so that we minimize that

3655

02:35:43,990 --> 02:35:42,560

bone density loss when we get back to

3656

02:35:45,910 --> 02:35:44,000

the earth so those are a few challenges

3657

02:35:48,550 --> 02:35:45,920

that we have on our self and our daily

3658

02:35:52,309 --> 02:35:49,670

we have another

3659

02:35:54,790 --> 02:35:52,319

question here from twitter user isgamore

3660

02:35:56,630 --> 02:35:54,800

the idea of extending iss beyond 2020

3661

02:35:58,230 --> 02:35:56,640

seems to be a given are there any real

3662

02:36:05,750 --> 02:35:58,240

hurdles that must be cleared besides

3663

02:36:11,510 --> 02:36:08,630

i think one of the big things is that

3664

02:36:12,790 --> 02:36:11,520

things tend to break down after after

3665

02:36:14,790 --> 02:36:12,800

they've been used for a certain amount

3666

02:36:16,550 --> 02:36:14,800

of time and engineers

3667

02:36:18,790 --> 02:36:16,560

built and designed and built the space

3668

02:36:21,510 --> 02:36:18,800

station tried really hard to use

3669

02:36:23,830 --> 02:36:21,520

equipment that had long life time but

3670

02:36:25,590 --> 02:36:23,840

you think about in your own home an air

3671

02:36:27,349 --> 02:36:25,600

conditioning unit is only going to last

3672

02:36:29,510 --> 02:36:27,359

for so many years before you either have

3673

02:36:31,830 --> 02:36:29,520

to replace the entire thing or replace

3674

02:36:33,990 --> 02:36:31,840

one of the one of the pieces of it

3675

02:36:37,270 --> 02:36:34,000

and here on the space station you know

3676

02:36:39,110 --> 02:36:37,280

luckily we do have the access of various

3677

02:36:41,670 --> 02:36:39,120

cargo vehicles that can bring up spare

3678

02:36:43,510 --> 02:36:41,680

parts but as the station ages i you know

3679

02:36:45,510 --> 02:36:43,520

i think more and more things might start

3680

02:36:46,950 --> 02:36:45,520

breaking and and it's hard to anticipate

3681

02:36:48,550 --> 02:36:46,960

exactly what's going to break like with

3682

02:36:50,630 --> 02:36:48,560

the spacesuit problem we had a couple

3683

02:36:52,389 --> 02:36:50,640

weeks ago nobody probably ever would

3684

02:36:54,790 --> 02:36:52,399

have thought that we would have had that

3685

02:36:56,630 --> 02:36:54,800

malfunction but we did and i think that

3686

02:36:58,550 --> 02:36:56,640

that's bound to happen and so i think

3687

02:36:59,830 --> 02:36:58,560

that will be a struggle as we continue

3688

02:37:01,510 --> 02:36:59,840

on but not something that's

3689

02:37:02,950 --> 02:37:01,520

insurmountable

3690

02:37:05,349 --> 02:37:02,960

in fact

3691

02:37:07,510 --> 02:37:05,359

yeah besides the fun of flying from one

3692

02:37:09,349 --> 02:37:07,520

end of the space station to the other um

3693

02:37:11,750 --> 02:37:09,359

given a little bit of free time that you

3694

02:37:13,349 --> 02:37:11,760

do get uh how much time do you spend

3695

02:37:15,910 --> 02:37:13,359

just looking out the window in the

3696

02:37:18,150 --> 02:37:15,920

cupola and then also could you describe

3697

02:37:19,830 --> 02:37:18,160

the first time on station when you went

3698

02:37:25,510 --> 02:37:19,840

in there what that feeling was like

3699

02:37:29,910 --> 02:37:27,110

yeah you hit the nail on the head the

3700

02:37:31,750 --> 02:37:29,920

cupola is just a magnificent place to go

3701

02:37:33,830 --> 02:37:31,760

and when both karen and i were here on

3702

02:37:36,150 --> 02:37:33,840

our shuttle flights that cupola was not

3703

02:37:37,429 --> 02:37:36,160

part of the space station so for me the

3704

02:37:39,270 --> 02:37:37,439

first time

3705

02:37:40,870 --> 02:37:39,280

seeing it for real with my own eyes was

3706

02:37:43,990 --> 02:37:40,880

when i arrived here

3707

02:37:47,349 --> 02:37:44,000

um several months ago and just like you

3708

02:37:49,510 --> 02:37:47,359

alluded to it's breathtaking i mean you

3709

02:37:51,670 --> 02:37:49,520

i remember actually the first time is

3710

02:37:53,270 --> 02:37:51,680

when i opened the window shutters myself

3711

02:37:55,670 --> 02:37:53,280

so each of the windows has a shutter

3712

02:37:58,550 --> 02:37:55,680

that you can open it with a manual turn

3713

02:38:00,790 --> 02:37:58,560

and as i did i remember just looking out

3714

02:38:02,389 --> 02:38:00,800

there and seeing the earth out of one

3715

02:38:04,070 --> 02:38:02,399

window then another window and another

3716

02:38:06,550 --> 02:38:04,080

window and it seemed like i was in my

3717

02:38:09,670 --> 02:38:06,560

own real life imax movie or something

3718

02:38:11,590 --> 02:38:09,680

360 degrees of the earth and

3719

02:38:13,429 --> 02:38:11,600

and the other thing that's interesting

3720

02:38:15,270 --> 02:38:13,439

that you don't really think about

3721

02:38:16,950 --> 02:38:15,280

is it's on the bottom of the space

3722

02:38:19,190 --> 02:38:16,960

station and you go in there and your

3723

02:38:21,190 --> 02:38:19,200

head is directly to the earth so you're

3724

02:38:23,830 --> 02:38:21,200

upside down and it's a little

3725

02:38:25,590 --> 02:38:23,840

disorienting at first as if you're in an

3726

02:38:26,790 --> 02:38:25,600

airplane and you go inverted and you're

3727

02:38:28,469 --> 02:38:26,800

flying over

3728

02:38:30,469 --> 02:38:28,479

you're an area that you you're familiar

3729

02:38:32,070 --> 02:38:30,479

with like your hometown or something

3730

02:38:34,469 --> 02:38:32,080

you you look left and you look right you

3731

02:38:36,710 --> 02:38:34,479

have to reorient your brain and and that

3732

02:38:38,389 --> 02:38:36,720

took me some time getting used to okay

3733

02:38:40,309 --> 02:38:38,399

left means right right means left and

3734

02:38:42,389 --> 02:38:40,319

that sort of thing

3735

02:38:43,750 --> 02:38:42,399

so it's just a really really neat place

3736

02:38:45,110 --> 02:38:43,760

to go and i think the first part of your

3737

02:38:47,190 --> 02:38:45,120

question is how much time do we spend

3738

02:38:49,830 --> 02:38:47,200

there well as much time as we can

3739

02:38:51,590 --> 02:38:49,840

after the our evening dpc daily planning

3740

02:38:55,110 --> 02:38:51,600

conference we'll have dinner and then

3741

02:38:57,110 --> 02:38:55,120

usually um people trickle up to the

3742

02:38:58,790 --> 02:38:57,120

cupola to take pictures and see where we

3743

02:39:02,469 --> 02:38:58,800

are on the planet and just look before

3744

02:39:07,110 --> 02:39:05,510

twitter user chief r.a asks do you feel

3745

02:39:13,670 --> 02:39:07,120

ready to go to mars if you could leave

3746

02:39:16,389 --> 02:39:15,429

that's an interesting question to try to

3747

02:39:17,910 --> 02:39:16,399

answer

3748

02:39:19,429 --> 02:39:17,920

i think um

3749

02:39:22,309 --> 02:39:19,439

you know i could look at it personally

3750

02:39:24,550 --> 02:39:22,319

me ready or or us ready

3751
02:39:26,870 --> 02:39:24,560
again we could go back looking at us and

3752
02:39:29,270 --> 02:39:26,880
whether whether you know people are

3753
02:39:31,590 --> 02:39:29,280
ready to go in general the problems like

3754
02:39:33,429 --> 02:39:31,600
i just talked about fixing things

3755
02:39:34,710 --> 02:39:33,439
we have to remember that when we start a

3756
02:39:36,150 --> 02:39:34,720
trip to mars we're not going to have

3757
02:39:37,910 --> 02:39:36,160
those cargo vehicles to come and

3758
02:39:40,230 --> 02:39:37,920
resupply us we're not going to have the

3759
02:39:41,910 --> 02:39:40,240
cargo vehicles to to send up at the last

3760
02:39:44,710 --> 02:39:41,920
moment a spare part that we didn't

3761
02:39:46,070 --> 02:39:44,720
realize we were going to need and so

3762
02:39:47,750 --> 02:39:46,080
you know the work we're doing here on

3763
02:39:50,070 --> 02:39:47,760

the space station just running the space

3764

02:39:52,710 --> 02:39:50,080

station on a day-to-day basis i think is

3765

02:39:54,870 --> 02:39:52,720

a good test bed for for what we're going

3766

02:39:56,469 --> 02:39:54,880

to need to go to mars but i think i

3767

02:39:59,110 --> 02:39:56,479

think there's still some work to be done

3768

02:40:00,630 --> 02:39:59,120

i i'm confident we'll get there but um i

3769

02:40:02,469 --> 02:40:00,640

think there's just a lot of things to

3770

02:40:04,710 --> 02:40:02,479

think about knowing that it's it's a

3771

02:40:06,950 --> 02:40:04,720

trip that that can't be resupplied can't

3772

02:40:09,750 --> 02:40:06,960

be um you know once you're going you're

3773

02:40:11,110 --> 02:40:09,760

going and uh you know i i think we'll

3774

02:40:12,469 --> 02:40:11,120

get there eventually but i think right

3775

02:40:13,429 --> 02:40:12,479

now there's there's still a lot of work

3776

02:40:16,070 --> 02:40:13,439

to do

3777

02:40:19,349 --> 02:40:16,080

okay one more question from the audience

3778

02:40:21,349 --> 02:40:19,359

banking off of the uh the cupola um we

3779

02:40:23,429 --> 02:40:21,359

know that luca seems to have an affinity

3780

02:40:25,349 --> 02:40:23,439

of imaging italy

3781

02:40:27,670 --> 02:40:25,359

since we didn't we know that chris is uh

3782

02:40:33,349 --> 02:40:27,680

tweetless what are your favorite spots

3783

02:40:36,870 --> 02:40:35,349

well thank you for giving me opportunity

3784

02:40:39,030 --> 02:40:36,880

to answer this question with more than

3785

02:40:39,990 --> 02:40:39,040

140 characters

3786

02:40:42,630 --> 02:40:40,000

um

3787

02:40:45,590 --> 02:40:42,640

my favorite place to look

3788

02:40:47,750 --> 02:40:45,600

is um i i've said this a couple times

3789

02:40:49,510 --> 02:40:47,760

and i really mean it it's where

3790

02:40:51,349 --> 02:40:49,520

the uh

3791

02:40:53,429 --> 02:40:51,359

the oceans meet

3792

02:40:55,190 --> 02:40:53,439

river areas you know river deltas and

3793

02:40:56,710 --> 02:40:55,200

things you just get really really

3794

02:40:58,950 --> 02:40:56,720

interesting and neat

3795

02:41:01,910 --> 02:40:58,960

patterns in the ocean and the brown

3796

02:41:04,070 --> 02:41:01,920

where the brown river meets the blues of

3797

02:41:05,910 --> 02:41:04,080

the ocean and you can see that the tidal

3798

02:41:07,830 --> 02:41:05,920

patterns and things like this i just

3799

02:41:10,469 --> 02:41:07,840

find that really really cool so that's

3800

02:41:12,870 --> 02:41:10,479

the area that i like to to look around

3801

02:41:15,429 --> 02:41:12,880

and usually there's a lot of cities

3802

02:41:18,550 --> 02:41:15,439

obviously around the uh the oceans as

3803

02:41:21,349 --> 02:41:18,560

well so at night it's it's an an easier

3804

02:41:23,910 --> 02:41:21,359

place to find major cities and you can

3805

02:41:27,590 --> 02:41:23,920

kind of direct your vision uh okay

3806

02:41:29,910 --> 02:41:27,600

that's um that's washington dc new york

3807

02:41:32,150 --> 02:41:29,920

there's boston kind of a thing and as

3808

02:41:34,230 --> 02:41:32,160

you go up the coastline so the i have an

3809

02:41:36,630 --> 02:41:34,240

affinity for the coastline maybe it's my

3810

02:41:38,150 --> 02:41:36,640

navy background i don't know

3811

02:41:40,309 --> 02:41:38,160

karen chris i know we lose you in just a

3812

02:41:41,670 --> 02:41:40,319

couple of minutes so to to here to close

3813

02:41:43,030 --> 02:41:41,680

us out as our is our final speaker for

3814

02:41:44,710 --> 02:41:43,040

the day to say a few words to you it's

3815

02:41:49,030 --> 02:41:44,720

nasa administrator charlie bolden

3816

02:41:52,230 --> 02:41:50,630

hi karen and chris i know you all have

3817

02:41:54,469 --> 02:41:52,240

to get back to work but let me thank you

3818

02:41:57,349 --> 02:41:54,479

very much uh for sharing your time with

3819

02:41:59,510 --> 02:41:57,359

us today it's fascinating watching you

3820

02:42:01,750 --> 02:41:59,520

and i i listened to the questions

3821

02:42:04,150 --> 02:42:01,760

uh thinking of how i might have answered

3822

02:42:06,870 --> 02:42:04,160

them and i realized how old i am and how

3823

02:42:08,469 --> 02:42:06,880

long it's been since i was where you are

3824

02:42:09,990 --> 02:42:08,479

and but i want to thank you for

3825

02:42:11,750 --> 02:42:10,000

everything i want to thank you for the

3826

02:42:13,510 --> 02:42:11,760

just the tremendous job of outreach that

3827

02:42:14,389 --> 02:42:13,520

you have been doing throughout your time

3828

02:42:17,030 --> 02:42:14,399

there

3829

02:42:18,950 --> 02:42:17,040

uh and and congratulations we're

3830

02:42:22,070 --> 02:42:18,960

celebrating a great anniversary here

3831

02:42:24,469 --> 02:42:22,080

today uh anniversary of of curiosity's

3832

02:42:26,550 --> 02:42:24,479

landing and i know where i was because i

3833

02:42:31,670 --> 02:42:26,560

was sweating beads at jpl so thanks to

3834

02:42:37,590 --> 02:42:33,190

thank you sir it was an honor to be with

3835

02:42:42,150 --> 02:42:39,910

congratulations to the entire mars

3836

02:42:44,389 --> 02:42:42,160

curiosity team

3837

02:42:46,550 --> 02:42:44,399

thanks so much and let me uh again

3838

02:42:48,230 --> 02:42:46,560

welcome all of you here today and and

3839

02:42:50,550 --> 02:42:48,240

actually to thank you for coming out and

3840

02:42:53,030 --> 02:42:50,560

helping us celebrate the the one year

3841

02:42:54,150 --> 02:42:53,040

anniversary of curiosity's landing on

3842

02:42:56,389 --> 02:42:54,160

mars

3843

02:42:57,830 --> 02:42:56,399

as i as i just mentioned to chris and

3844

02:43:00,150 --> 02:42:57,840

karen um

3845

02:43:02,630 --> 02:43:00,160

i i was privileged to be in the control

3846

02:43:03,990 --> 02:43:02,640

center at jpl and and we were literally

3847

02:43:06,309 --> 02:43:04,000

sweating beads and biting our

3848

02:43:08,309 --> 02:43:06,319

fingernails uh as some of you may

3849

02:43:10,070 --> 02:43:08,319

remember from wherever you look

3850

02:43:13,670 --> 02:43:10,080

i think it's incredibly fitting that we

3851
02:43:15,590 --> 02:43:13,680
ended today's uh formal presentations

3852
02:43:17,270 --> 02:43:15,600
uh with a conversation with our

3853
02:43:19,670 --> 02:43:17,280
astronauts on board the international

3854
02:43:22,550 --> 02:43:19,680
space station because station is our toe

3855
02:43:25,429 --> 02:43:22,560
hold on the universe it is in fact uh

3856
02:43:26,469 --> 02:43:25,439
our our waypoint to mars and it is in

3857
02:43:28,630 --> 02:43:26,479
fact the

3858
02:43:31,270 --> 02:43:28,640
probably the last outpost of humanity

3859
02:43:33,429 --> 02:43:31,280
before we find ourselves uh permanently

3860
02:43:35,990 --> 02:43:33,439
on mars one of these days

3861
02:43:38,630 --> 02:43:36,000
you've heard a lot of about the amazing

3862
02:43:40,950 --> 02:43:38,640
launch uh the seven minutes of terror

3863
02:43:43,110 --> 02:43:40,960

the entry and landing on mars

3864

02:43:45,190 --> 02:43:43,120
and almost daily breakthrough uh

3865

02:43:48,389 --> 02:43:45,200
discoveries that this that curiosity

3866

02:43:49,269 --> 02:43:48,399
continues to make uh over these past 12

3867

02:43:51,349 --> 02:43:49,279
months

3868

02:43:53,349 --> 02:43:51,359
we've talked about other robotic

3869

02:43:55,910 --> 02:43:53,359
missions to the red planet that nasa is

3870

02:43:58,389 --> 02:43:55,920
now planning and i just want to spend a

3871

02:44:00,230 --> 02:43:58,399
few moments talking about why mars is

3872

02:44:02,950 --> 02:44:00,240
the linchpin of nasa's planetary

3873

02:44:05,429 --> 02:44:02,960
exploration strategy and how curiosity

3874

02:44:07,750 --> 02:44:05,439
and other robotic missions are setting

3875

02:44:10,469 --> 02:44:07,760
the stage for the main event a human

3876

02:44:12,389 --> 02:44:10,479

mission to mars in the 2030s

3877

02:44:14,150 --> 02:44:12,399

first of all why mars

3878

02:44:17,030 --> 02:44:14,160

you know hopefully everybody in this

3879

02:44:18,710 --> 02:44:17,040

room has an answer to that

3880

02:44:21,429 --> 02:44:18,720

or some of you may be sitting here and

3881

02:44:24,389 --> 02:44:21,439

you came out because you don't know

3882

02:44:26,230 --> 02:44:24,399

and and you're skeptical and you say i

3883

02:44:27,990 --> 02:44:26,240

think it's stupid you know why do we

3884

02:44:30,389 --> 02:44:28,000

want to do that cost much uh it's

3885

02:44:32,630 --> 02:44:30,399

dangerous uh it takes a lot of time so

3886

02:44:33,910 --> 02:44:32,640

why mars first

3887

02:44:35,429 --> 02:44:33,920

let me say

3888

02:44:37,429 --> 02:44:35,439

that you know mars is the most

3889

02:44:38,790 --> 02:44:37,439

earth-like of any of the planets in our

3890

02:44:41,830 --> 02:44:38,800

solar system

3891

02:44:42,950 --> 02:44:41,840

uh and so it's why we choose to explore

3892

02:44:45,750 --> 02:44:42,960

it

3893

02:44:48,309 --> 02:44:45,760

if life exists beyond earth and i am one

3894

02:44:51,190 --> 02:44:48,319

who believes that it may very well

3895

02:44:53,349 --> 02:44:51,200

uh mars for me is the most likely place

3896

02:44:56,230 --> 02:44:53,359

that that life will be found

3897

02:44:58,630 --> 02:44:56,240

what we can learn from mars about uh

3898

02:45:01,190 --> 02:44:58,640

about our own earth and what we can

3899

02:45:02,790 --> 02:45:01,200

learn about mars from further studies

3900

02:45:04,790 --> 02:45:02,800

will improve our understanding of

3901
02:45:06,230 --> 02:45:04,800
planetary and biological processes that

3902
02:45:08,790 --> 02:45:06,240
affect the earth

3903
02:45:11,190 --> 02:45:08,800
and our life here from the core

3904
02:45:12,389 --> 02:45:11,200
uh of of our earth to the top of our

3905
02:45:14,790 --> 02:45:12,399
atmosphere

3906
02:45:17,510 --> 02:45:14,800
our conversation with astronauts today

3907
02:45:20,150 --> 02:45:17,520
reminds us that iss is our springboard

3908
02:45:22,469 --> 02:45:20,160
to nasa's next big leap in exploration

3909
02:45:25,030 --> 02:45:22,479
our activities and experiences on the

3910
02:45:27,670 --> 02:45:25,040
iss are significantly contributing to

3911
02:45:29,990 --> 02:45:27,680
sending humans to mars in fact

3912
02:45:31,750 --> 02:45:30,000
when we sit around in quiet meetings if

3913
02:45:33,429 --> 02:45:31,760

there are any such thing here at nasa

3914

02:45:35,830 --> 02:45:33,439

headquarters

3915

02:45:37,510 --> 02:45:35,840

but when we sit around in our meetings

3916

02:45:39,349 --> 02:45:37,520

our safety guys

3917

02:45:41,670 --> 02:45:39,359

always remind us

3918

02:45:44,309 --> 02:45:41,680

as we deliberate on what next you know

3919

02:45:46,630 --> 02:45:44,319

they they ask us over and over um

3920

02:45:49,110 --> 02:45:46,640

are we serious about going to mars

3921

02:45:50,950 --> 02:45:49,120

we say yep they say okay

3922

02:45:52,950 --> 02:45:50,960

it's what we're about to do going to

3923

02:45:54,710 --> 02:45:52,960

contribute to going to mars we say yep

3924

02:45:56,150 --> 02:45:54,720

they said all right we're okay with it

3925

02:45:58,389 --> 02:45:56,160

because we shouldn't be putting people

3926

02:45:59,510 --> 02:45:58,399

at risk if we're not really trying to go

3927

02:46:01,030 --> 02:45:59,520

there

3928

02:46:02,469 --> 02:46:01,040

because we're doing some we're hanging

3929

02:46:04,389 --> 02:46:02,479

it out every once in a while and we're

3930

02:46:05,670 --> 02:46:04,399

doing some pretty risky stuff and we're

3931

02:46:07,910 --> 02:46:05,680

going to do things that are even more

3932

02:46:10,070 --> 02:46:07,920

risky than anything you've ever seen

3933

02:46:10,870 --> 02:46:10,080

nasa attempt before in the coming years

3934

02:46:13,590 --> 02:46:10,880

so

3935

02:46:15,349 --> 02:46:13,600

um you know we we need to make sure that

3936

02:46:18,469 --> 02:46:15,359

everything we do is significantly

3937

02:46:20,950 --> 02:46:18,479

contributing to sending humans to mars

3938

02:46:22,950 --> 02:46:20,960

nasa and our international partners are

3939

02:46:25,190 --> 02:46:22,960

confronting challenges on a daily basis

3940

02:46:26,150 --> 02:46:25,200

that are critical to sending humans to

3941

02:46:28,070 --> 02:46:26,160

mars

3942

02:46:29,670 --> 02:46:28,080

this includes life support systems and

3943

02:46:31,590 --> 02:46:29,680

the challenges in maintaining them you

3944

02:46:33,429 --> 02:46:31,600

heard chris and and karen in their

3945

02:46:34,469 --> 02:46:33,439

conversation you know what did karen say

3946

02:46:37,190 --> 02:46:34,479

who would have ever thought we'd have

3947

02:46:40,309 --> 02:46:37,200

had a water leak the magnitude that we

3948

02:46:42,469 --> 02:46:40,319

had on the emu on the spacesuit until it

3949

02:46:45,269 --> 02:46:42,479

actually happened uh you know if that

3950

02:46:47,269 --> 02:46:45,279

had been on the way to mars

3951

02:46:48,870 --> 02:46:47,279

there's no getting a replacement unit

3952

02:46:51,030 --> 02:46:48,880

from the ground there's no getting any

3953

02:46:53,990 --> 02:46:51,040

tools from the ground the way that we're

3954

02:46:55,750 --> 02:46:54,000

doing to help us troubleshoot uh the emu

3955

02:46:58,070 --> 02:46:55,760

right now so we've gotta we've gotta

3956

02:47:00,070 --> 02:46:58,080

make sure that the systems are solid uh

3957

02:47:01,269 --> 02:47:00,080

when we when we send a crew on the way

3958

02:47:03,269 --> 02:47:01,279

to mars

3959

02:47:05,349 --> 02:47:03,279

uh there are things about the human body

3960

02:47:07,590 --> 02:47:05,359

uh in the microgravity environment that

3961

02:47:09,349 --> 02:47:07,600

we still don't understand

3962

02:47:12,070 --> 02:47:09,359

and so human health and performance

3963

02:47:14,469 --> 02:47:12,080

becomes most important to us and chris

3964

02:47:16,550 --> 02:47:14,479

alluded to it again we have to remember

3965

02:47:17,990 --> 02:47:16,560

where when we go to mars

3966

02:47:19,590 --> 02:47:18,000

it is not

3967

02:47:22,469 --> 02:47:19,600

like going to the international space

3968

02:47:25,429 --> 02:47:22,479

station when we go to station we go

3969

02:47:27,830 --> 02:47:25,439

prepared to live six months in a micro

3970

02:47:29,030 --> 02:47:27,840

gravity environment when we go to mars

3971

02:47:30,389 --> 02:47:29,040

we're going to have to prepare to live

3972

02:47:31,510 --> 02:47:30,399

eight months in a micro gravity

3973

02:47:33,910 --> 02:47:31,520

environment

3974

02:47:35,429 --> 02:47:33,920

only to transfer to a gravity

3975

02:47:38,630 --> 02:47:35,439

environment where we're going to be for

3976

02:47:41,349 --> 02:47:38,640

at least a year and maybe even more time

3977

02:47:43,269 --> 02:47:41,359

the body has not done that before where

3978

02:47:45,590 --> 02:47:43,279

it goes

3979

02:47:47,269 --> 02:47:45,600

microgravity to a gravity environment

3980

02:47:49,750 --> 02:47:47,279

for a temporary stay back into

3981

02:47:52,150 --> 02:47:49,760

microgravity and then back to earth

3982

02:47:54,550 --> 02:47:52,160

so so challenges abound

3983

02:47:56,870 --> 02:47:54,560

we're using iss as a test bed for

3984

02:47:58,469 --> 02:47:56,880

technologies and systems and you heard

3985

02:48:00,469 --> 02:47:58,479

some of the presenters this morning talk

3986

02:48:02,790 --> 02:48:00,479

about those technologies and systems

3987

02:48:04,630 --> 02:48:02,800

that are under development for mars

3988

02:48:06,950 --> 02:48:04,640

exploration with humans

3989

02:48:08,550 --> 02:48:06,960

as you've heard our goal in goals

3990

02:48:10,950 --> 02:48:08,560

include both new

3991

02:48:13,429 --> 02:48:10,960

path-breaking robotic missions to mars

3992

02:48:15,349 --> 02:48:13,439

and a groundbreaking asteroid mission on

3993

02:48:16,550 --> 02:48:15,359

the way to our ultimate goal of humans

3994

02:48:19,190 --> 02:48:16,560

on mars

3995

02:48:21,349 --> 02:48:19,200

so the wheels of curiosity are literally

3996

02:48:22,630 --> 02:48:21,359

blazing the trail for human footprints

3997

02:48:24,790 --> 02:48:22,640

on mars

3998

02:48:27,349 --> 02:48:24,800

our success in landing a heavier payload

3999

02:48:29,429 --> 02:48:27,359

on mars with increased precision brings

4000

02:48:30,550 --> 02:48:29,439

us closer to developing capabilities

4001
02:48:32,870 --> 02:48:30,560
necessary

4002
02:48:34,950 --> 02:48:32,880
for human missions to mars

4003
02:48:36,790 --> 02:48:34,960
measurements taken by msl as it

4004
02:48:39,190 --> 02:48:36,800
delivered the curiosity rover to mars

4005
02:48:41,670 --> 02:48:39,200
last year have provided nasa the

4006
02:48:43,830 --> 02:48:41,680
information to help design systems to

4007
02:48:47,110 --> 02:48:43,840
protect human explorers from radiation

4008
02:48:49,269 --> 02:48:47,120
exposure in future deep space missions

4009
02:48:51,349 --> 02:48:49,279
and as you have also heard our recently

4010
02:48:54,230 --> 02:48:51,359
announced mission to identify

4011
02:48:55,910 --> 02:48:54,240
capture redirect and sample an asteroid

4012
02:48:57,990 --> 02:48:55,920
would mark an unprecedented

4013
02:48:59,830 --> 02:48:58,000

technological achievement to help reach

4014

02:49:03,190 --> 02:48:59,840

the president's goal of sending human to

4015

02:49:05,510 --> 02:49:03,200

humans to mars in the 2030s

4016

02:49:09,110 --> 02:49:05,520

it's important to remember that the us

4017

02:49:12,070 --> 02:49:09,120

through nasa was the first and still the

4018

02:49:15,110 --> 02:49:12,080

only nation to land humans on the moon

4019

02:49:17,429 --> 02:49:15,120

in 1969 and after that

4020

02:49:21,030 --> 02:49:17,439

we're determined that america leads the

4021

02:49:21,990 --> 02:49:21,040

way to first footprints on mars

4022

02:49:24,230 --> 02:49:22,000

we know

4023

02:49:26,070 --> 02:49:24,240

we could not do the amazing things we do

4024

02:49:29,510 --> 02:49:26,080

without the support of the president the

4025

02:49:30,950 --> 02:49:29,520

congress and most importantly you the

4026

02:49:32,550 --> 02:49:30,960

american people

4027

02:49:34,550 --> 02:49:32,560

so

4028

02:49:37,990 --> 02:49:34,560

as we wish curiosity a happy first

4029

02:49:39,990 --> 02:49:38,000

birthday we offer you our thanks

4030

02:49:42,550 --> 02:49:40,000

with your continued interest and support

4031

02:49:44,389 --> 02:49:42,560

i have no doubt that america will remain

4032

02:49:46,389 --> 02:49:44,399

the world's leading space-faring nation

4033

02:49:48,630 --> 02:49:46,399

as we move towards sending

4034

02:49:50,230 --> 02:49:48,640

humans farther into space than we've

4035

02:49:52,870 --> 02:49:50,240

ever gone before

4036

02:49:54,710 --> 02:49:52,880

including an asteroid in mars

4037

02:49:57,750 --> 02:49:54,720

once only dreams

4038

02:50:00,389 --> 02:49:57,760

these goals are now within our grasp

4039

02:50:02,389 --> 02:50:00,399

and we hope you're as excited as we are

4040

02:50:04,389 --> 02:50:02,399

about accepting this challenge

4041

02:50:07,190 --> 02:50:04,399

uh thank you again for coming today and

4042

02:50:09,429 --> 02:50:07,200

i i think there's a little time for a

4043

02:50:10,950 --> 02:50:09,439

few questions if you have them

4044

02:50:18,070 --> 02:50:10,960

you won't let me get away from the

4045

02:50:20,870 --> 02:50:19,590

charlie let me let me start off uh

4046

02:50:23,190 --> 02:50:20,880

there's one thing i like to remind

4047

02:50:24,950 --> 02:50:23,200

people we didn't get to tell a lot of

4048

02:50:26,469 --> 02:50:24,960

the orion sls story because we were

4049

02:50:27,750 --> 02:50:26,479

focused on some overcoming some of the

4050

02:50:29,349 --> 02:50:27,760

challenges and ways we're doing that can

4051
02:50:30,389 --> 02:50:29,359
you say there's a couple of words about

4052
02:50:31,910 --> 02:50:30,399
some of the hardware we're building the

4053
02:50:33,030 --> 02:50:31,920
new rocket and spacecraft will help

4054
02:50:35,030 --> 02:50:33,040
enable this

4055
02:50:36,550 --> 02:50:35,040
path to mars i think somebody's talked

4056
02:50:38,230 --> 02:50:36,560
already or at least hopefully someone's

4057
02:50:39,750 --> 02:50:38,240
talked today a little bit about our

4058
02:50:41,910 --> 02:50:39,760
commercial ventures

4059
02:50:43,590 --> 02:50:41,920
we already have two commercial providers

4060
02:50:45,269 --> 02:50:43,600
that are taking cargo

4061
02:50:47,750 --> 02:50:45,279
or at least two that will be taking

4062
02:50:49,830 --> 02:50:47,760
cargo spacex's had two successful

4063
02:50:53,510 --> 02:50:49,840

launches with their dragon module taking

4064

02:50:56,870 --> 02:50:53,520

uh taken cargo to station and uh antares

4065

02:50:59,190 --> 02:50:56,880

will be launching uh the the um

4066

02:51:00,950 --> 02:50:59,200

cygnus module for orbital sciences

4067

02:51:02,710 --> 02:51:00,960

hopefully next month so that will give

4068

02:51:05,990 --> 02:51:02,720

us a second american company taking

4069

02:51:08,150 --> 02:51:06,000

cargo then we have boeing uh spacex and

4070

02:51:09,590 --> 02:51:08,160

sierra nevada that are vying for the

4071

02:51:11,030 --> 02:51:09,600

opportunity to begin to take our

4072

02:51:13,190 --> 02:51:11,040

astronauts from earth to the

4073

02:51:15,349 --> 02:51:13,200

international space station and love

4074

02:51:17,269 --> 02:51:15,359

other low-earth orbit destinations what

4075

02:51:19,030 --> 02:51:17,279

that's allowed us to do is to get out of

4076
02:51:21,110 --> 02:51:19,040
the low earth orbit business to get out

4077
02:51:23,910 --> 02:51:21,120
of the access to space business and

4078
02:51:26,309 --> 02:51:23,920
really focus on putting together uh the

4079
02:51:28,389 --> 02:51:26,319
systems that will allow us to take uh

4080
02:51:30,070 --> 02:51:28,399
humans take our astronauts to asteroids

4081
02:51:32,150 --> 02:51:30,080
and onto mars and perhaps even other

4082
02:51:35,510 --> 02:51:32,160
places and those two vehicles that we

4083
02:51:37,190 --> 02:51:35,520
have chosen uh are called the sls right

4084
02:51:39,590 --> 02:51:37,200
now lacking a name and everybody's

4085
02:51:41,349 --> 02:51:39,600
pressing me to get a name but i like sls

4086
02:51:42,550 --> 02:51:41,359
the space launch system or heavy lift

4087
02:51:45,750 --> 02:51:42,560
launch vehicle

4088
02:51:47,590 --> 02:51:45,760

and uh in orion the crew module its

4089

02:51:48,870 --> 02:51:47,600

formal name is multi-purpose crew

4090

02:51:51,190 --> 02:51:48,880

vehicle

4091

02:51:52,230 --> 02:51:51,200

they are well on their way to being

4092

02:51:53,830 --> 02:51:52,240

developed

4093

02:51:55,750 --> 02:51:53,840

we just finished what we call a

4094

02:51:58,630 --> 02:51:55,760

preliminary design review which was a

4095

02:52:00,389 --> 02:51:58,640

very critical milestone for sls up at

4096

02:52:01,830 --> 02:52:00,399

the marshall space flight center just

4097

02:52:04,790 --> 02:52:01,840

last month

4098

02:52:07,990 --> 02:52:04,800

we'll have a similar milestone come for

4099

02:52:11,349 --> 02:52:08,000

orion this fall and that'll tell us that

4100

02:52:13,670 --> 02:52:11,359

that we're on a a steady path to having

4101
02:52:16,550 --> 02:52:13,680
both of these vehicles ready to fly

4102
02:52:18,870 --> 02:52:16,560
orion the crew vehicle in a shell of a

4103
02:52:22,950 --> 02:52:18,880
form will fly its first time

4104
02:52:24,790 --> 02:52:22,960
uh the fall of next year fall of 2014

4105
02:52:27,510 --> 02:52:24,800
we'll launch it on a delta iv rocket

4106
02:52:30,389 --> 02:52:27,520
from cape canaveral florida and send it

4107
02:52:32,230 --> 02:52:30,399
into an orbit that uh will get it high

4108
02:52:34,230 --> 02:52:32,240
enough and fast enough such that when it

4109
02:52:36,070 --> 02:52:34,240
comes back to reenter earth's atmosphere

4110
02:52:38,389 --> 02:52:36,080
it's going at about the speeds that we

4111
02:52:39,910 --> 02:52:38,399
would fly for a mission back from the

4112
02:52:41,590 --> 02:52:39,920
moon or from mars so we want to

4113
02:52:43,910 --> 02:52:41,600

demonstrate that it can withstand the

4114

02:52:46,710 --> 02:52:43,920

pressures and temperatures of re-entry

4115

02:52:49,349 --> 02:52:46,720

at those speeds sls is scheduled for its

4116

02:52:52,550 --> 02:52:49,359

first flight in 2017. we'll put it

4117

02:52:53,910 --> 02:52:52,560

together again with an uncrewed uh orion

4118

02:52:56,230 --> 02:52:53,920

module and that'll be the first time

4119

02:52:58,469 --> 02:52:56,240

that you actually see us launch and fly

4120

02:53:01,750 --> 02:52:58,479

them as an integrated system and that's

4121

02:53:04,389 --> 02:53:01,760

leading us to a 20 hopefully 2020 uh

4122

02:53:07,190 --> 02:53:04,399

mission of sls on orion with a crude

4123

02:53:09,910 --> 02:53:07,200

vehicle this time and if all goes well

4124

02:53:11,269 --> 02:53:09,920

and the asteroid initiative that's that

4125

02:53:13,510 --> 02:53:11,279

i think we may have talked to you a

4126
02:53:15,110 --> 02:53:13,520
little bit about earlier today if all

4127
02:53:17,590 --> 02:53:15,120
that works out and we have an asteroid

4128
02:53:19,990 --> 02:53:17,600
that's in place in orbit uh around the

4129
02:53:22,309 --> 02:53:20,000
moon then that that mission may actually

4130
02:53:23,750 --> 02:53:22,319
be one of the first times that humans

4131
02:53:26,790 --> 02:53:23,760
have an opportunity to encounter an

4132
02:53:28,550 --> 02:53:26,800
asteroid but that's sort of a sls and

4133
02:53:30,630 --> 02:53:28,560
orion in a nutshell perfect we have a

4134
02:53:33,110 --> 02:53:30,640
question here in the middle

4135
02:53:35,910 --> 02:53:33,120
yeah um other than budget

4136
02:53:38,070 --> 02:53:35,920
what are the biggest political hurdles

4137
02:53:40,630 --> 02:53:38,080
that the organization faces and how can

4138
02:53:42,230 --> 02:53:40,640

we all help um

4139

02:53:43,510 --> 02:53:42,240

you know i can't tell you to go talk to

4140

02:53:46,070 --> 02:53:43,520

your congressman but talk to your

4141

02:53:48,790 --> 02:53:46,080

congressmen and senators

4142

02:53:50,870 --> 02:53:48,800

yeah the political hurdle right now is

4143

02:53:52,870 --> 02:53:50,880

is the same thing that all of you face

4144

02:53:53,750 --> 02:53:52,880

as american citizens you want things

4145

02:53:54,950 --> 02:53:53,760

done

4146

02:53:58,230 --> 02:53:54,960

and

4147

02:54:00,630 --> 02:53:58,240

we just need we need for all of us

4148

02:54:03,349 --> 02:54:00,640

both the administration and the congress

4149

02:54:05,910 --> 02:54:03,359

to begin to come together and focus on

4150

02:54:07,590 --> 02:54:05,920

the future focus on what it is that that

4151
02:54:10,230 --> 02:54:07,600
made america great and will keep us

4152
02:54:11,110 --> 02:54:10,240
great um at the pace we're going right

4153
02:54:11,910 --> 02:54:11,120
now

4154
02:54:13,110 --> 02:54:11,920
um

4155
02:54:15,990 --> 02:54:13,120
you know we

4156
02:54:17,990 --> 02:54:16,000
we we stand in jeopardy of not being the

4157
02:54:20,630 --> 02:54:18,000
great nation that we always have been

4158
02:54:23,510 --> 02:54:20,640
and that that all of us expect to be so

4159
02:54:25,590 --> 02:54:23,520
i'm certain that uh that the political

4160
02:54:27,990 --> 02:54:25,600
powers here in town will come together

4161
02:54:30,150 --> 02:54:28,000
over time you can already hear

4162
02:54:31,590 --> 02:54:30,160
uh conversation and inklings that people

4163
02:54:33,510 --> 02:54:31,600

are starting to realize that you know

4164

02:54:34,950 --> 02:54:33,520

there are important things to be done

4165

02:54:37,030 --> 02:54:34,960

but

4166

02:54:39,269 --> 02:54:37,040

doing things like deep space exploration

4167

02:54:41,190 --> 02:54:39,279

require willpower more than

4168

02:54:43,510 --> 02:54:41,200

more than much other things

4169

02:54:45,429 --> 02:54:43,520

we went to the moon because of president

4170

02:54:46,230 --> 02:54:45,439

john f kennedy who did not live to see

4171

02:54:48,150 --> 02:54:46,240

it

4172

02:54:49,510 --> 02:54:48,160

but we had a vision that humans should

4173

02:54:51,830 --> 02:54:49,520

should someday

4174

02:54:54,070 --> 02:54:51,840

and he was very specific before the end

4175

02:54:56,950 --> 02:54:54,080

of that decade before the end of the 60s

4176

02:54:59,349 --> 02:54:56,960

we should go to the moon with with men

4177

02:55:02,070 --> 02:54:59,359

then and bring them safely back to earth

4178

02:55:03,830 --> 02:55:02,080

and uh this president has told us senate

4179

02:55:05,190 --> 02:55:03,840

uh he he wants it to be in his lifetime

4180

02:55:08,630 --> 02:55:05,200

but he knows it won't be in his

4181

02:55:11,110 --> 02:55:08,640

presidency because it's the 19 the 2030s

4182

02:55:14,070 --> 02:55:11,120

and so he wants us to send humans to

4183

02:55:15,510 --> 02:55:14,080

mars and bring them safely back home um

4184

02:55:16,950 --> 02:55:15,520

and i think we can do that but it's

4185

02:55:18,870 --> 02:55:16,960

going to take

4186

02:55:20,710 --> 02:55:18,880

combined willpower on the part of both

4187

02:55:22,950 --> 02:55:20,720

the administration the congress with all

4188

02:55:24,070 --> 02:55:22,960

three the administration the congress

4189

02:55:26,389 --> 02:55:24,080

and the

4190

02:55:29,269 --> 02:55:26,399

public not the american public but the

4191

02:55:31,990 --> 02:55:29,279

world public this is not going to be

4192

02:55:33,670 --> 02:55:32,000

a u.s venture we'll lead it but but we

4193

02:55:35,670 --> 02:55:33,680

can't do it without the assistance of

4194

02:55:37,030 --> 02:55:35,680

other nations

4195

02:55:39,269 --> 02:55:37,040

charlie i know you have administrator

4196

02:55:40,870 --> 02:55:39,279

things to do so i'll let you go go run

4197

02:55:42,630 --> 02:55:40,880

back to running now thank you all very

4198

02:55:49,910 --> 02:55:42,640

much thank you

4199

02:55:53,110 --> 02:55:51,030

all right so that's going to conclude

4200

02:55:55,510 --> 02:55:53,120

today's event as i said at the outset it

4201

02:55:57,269 --> 02:55:55,520

was it's a very special day in recent

4202

02:55:59,990 --> 02:55:57,279

nasa history this first anniversary of

4203

02:56:01,910 --> 02:56:00,000

curiosity's landing on mars for all the

4204

02:56:03,670 --> 02:56:01,920

things we talked about for for more

4205

02:56:05,670 --> 02:56:03,680

curiosity science for the follow-on

4206

02:56:07,750 --> 02:56:05,680

missions like maven that are coming for

4207

02:56:08,950 --> 02:56:07,760

new nasa technologies and development to

4208

02:56:11,830 --> 02:56:08,960

keep up with the international space

4209

02:56:13,830 --> 02:56:11,840

station crew please visit nasa.gov for

4210

02:56:15,830 --> 02:56:13,840

that and more uh you can find all the

4211

02:56:17,990 --> 02:56:15,840

ways to connect with us and engage with

4212

02:56:20,790 --> 02:56:18,000

us on social media still and continue

4213

02:56:23,110 --> 02:56:20,800

this conversation at nasa.gov connect of

4214

02:56:25,910 --> 02:56:23,120

course you can find us at mars and at

4215

02:56:27,910 --> 02:56:25,920

excuse me at nasa at mars curiosity on

4216

02:56:29,590 --> 02:56:27,920

twitter and the uh the hashtag we'll be

4217

02:56:31,510 --> 02:56:29,600

using is one year on mars to continue

4218

02:56:33,990 --> 02:56:31,520

the conversation about this special

4219

02:56:35,670 --> 02:56:34,000

event so that's going to do it from nasa

4220

02:56:52,710 --> 02:56:35,680

headquarters i'm trent parado thank you