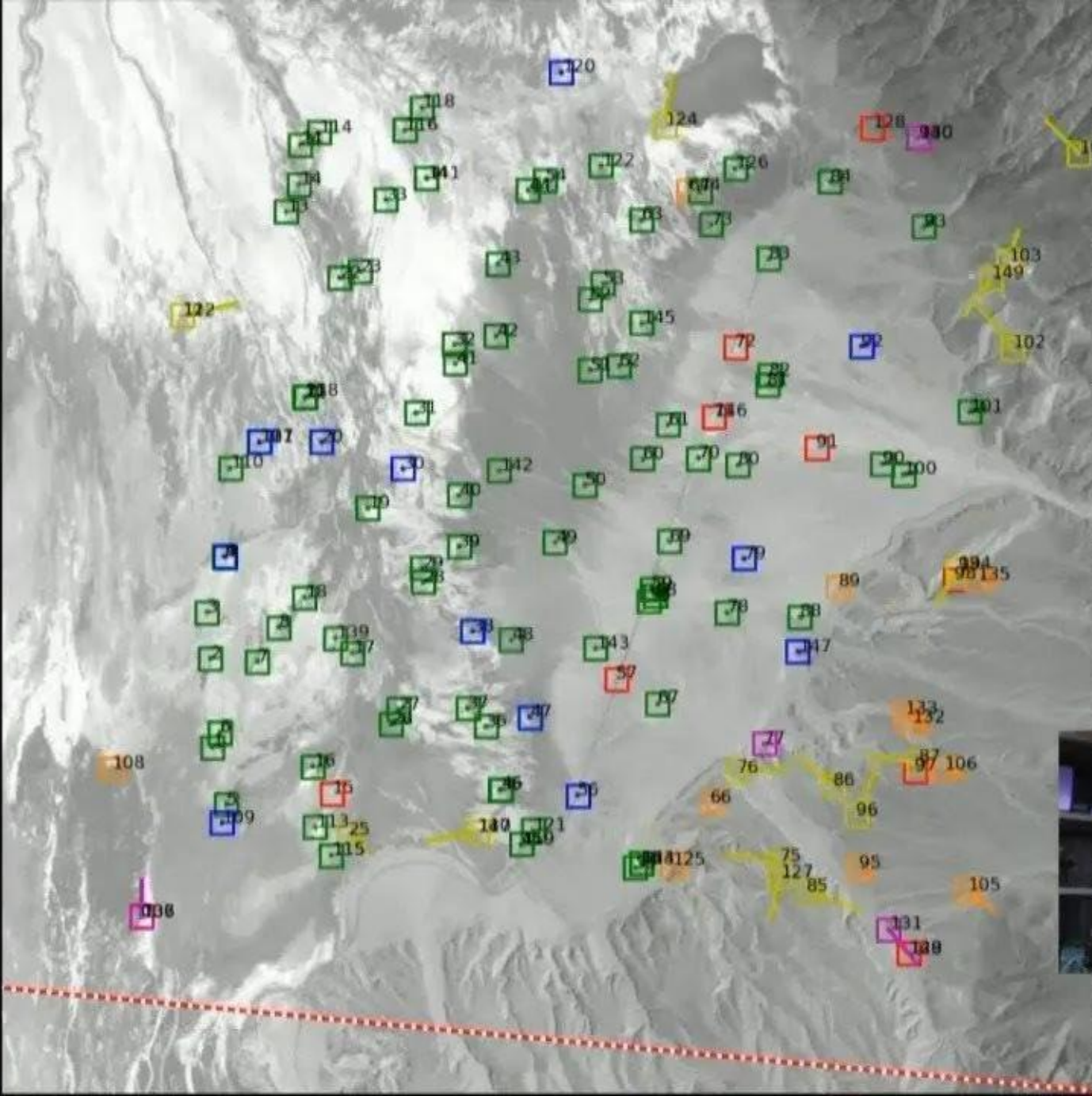


# #NASAatHome



1  
00:00:30,390 --> 00:00:20,760  
[Music]

2  
00:00:35,820 --> 00:00:30,400  
[Applause]

3  
00:00:37,350 --> 00:00:35,830  
[Music]

4  
00:00:44,450 --> 00:00:37,360  
[Applause]

5  
00:00:52,990 --> 00:00:44,460  
[Music]

6  
00:01:07,810 --> 00:00:55,760  
[Applause]

7  
00:01:12,109 --> 00:01:10,160  
hey welcome again to another edition of

8  
00:01:14,330 --> 00:01:12,119  
ness at home space board series I'm

9  
00:01:15,680 --> 00:01:14,340  
Joshua santoor your host traditionally

10  
00:01:18,320 --> 00:01:15,690  
coming to you from the Kennedy Space

11  
00:01:19,700 --> 00:01:18,330  
Center but today as usual for a series

12  
00:01:22,490 --> 00:01:19,710  
I'm coming to you live from my house

13  
00:01:25,520 --> 00:01:22,500

super excited today to get into talking

14

00:01:27,620 --> 00:01:25,530

about what's still happening at the

15

00:01:30,650 --> 00:01:27,630

Kennedy Space Center this beautiful

16

00:01:32,359 --> 00:01:30,660

rover the Mars 2020 Rover recently named

17

00:01:34,249 --> 00:01:32,369

perseverance if you look really closely

18

00:01:35,389 --> 00:01:34,259

up towards the wheels on the upper

19

00:01:37,070 --> 00:01:35,399

right-hand side you can actually see

20

00:01:39,440 --> 00:01:37,080

there's one of the bars it's labeled

21

00:01:41,139 --> 00:01:39,450

with perseverance so there is a ton of

22

00:01:43,460 --> 00:01:41,149

really cool work happening right now

23

00:01:45,109 --> 00:01:43,470

getting perseverance ready they're

24

00:01:47,029 --> 00:01:45,119

undergoing assembly they're getting

25

00:01:48,260 --> 00:01:47,039

ready to package this thing wheels have

26

00:01:50,029 --> 00:01:48,270

been installed parachutes have been

27

00:01:54,440 --> 00:01:50,039

installed the helicopter has been

28

00:01:57,199 --> 00:01:54,450

installed and we are charging towards a

29

00:01:58,910 --> 00:01:57,209

July launch so milestones happening

30

00:02:01,130 --> 00:01:58,920

every day new and exciting things

31

00:02:01,490 --> 00:02:01,140

happening all the time we are pumped

32

00:02:04,130 --> 00:02:01,500

about that

33

00:02:05,419 --> 00:02:04,140

so as we progress through this series

34

00:02:07,309 --> 00:02:05,429

and through this episode please feel

35

00:02:09,020 --> 00:02:07,319

free to send us your questions let us

36

00:02:11,690 --> 00:02:09,030

know what you'd like to see in future

37

00:02:13,070 --> 00:02:11,700

episodes and feel free to and please

38

00:02:15,530 --> 00:02:13,080

subscribe to our channel we'd love to

39

00:02:17,089 --> 00:02:15,540

have you follow us as we move on but I

40

00:02:20,449 --> 00:02:17,099

do want to go ahead and bring in our

41

00:02:22,940 --> 00:02:20,459

guests now so today I'm joined by two of

42

00:02:26,900 --> 00:02:22,950

our engineers from Mars Science

43

00:02:30,650 --> 00:02:26,910

Laboratory first up we've got al jinn al

44

00:02:32,839 --> 00:02:30,660

is the Mars 2020 entry descent and

45

00:02:34,910 --> 00:02:32,849

landing phase lead we'll talk more about

46

00:02:38,240 --> 00:02:34,920

EDL in a little bit but now thanks for

47

00:02:41,110 --> 00:02:38,250

joining us thanks for having me yeah we

48

00:02:44,710 --> 00:02:41,120

also have Chloe sack here is a Mars 2020

49

00:02:48,199 --> 00:02:44,720

ETL again entry descent and landing

50

00:02:50,360 --> 00:02:48,209

systems engineer so obviously these two

51  
00:02:52,280 --> 00:02:50,370  
folks are extremely critical to the work

52  
00:02:54,380 --> 00:02:52,290  
going on so let me just kind of open up

53  
00:02:56,900 --> 00:02:54,390  
and say what are you what are you

54  
00:03:01,039 --> 00:02:56,910  
working on for Mars 2020 what is really

55  
00:03:02,660 --> 00:03:01,049  
do how you want to start sure the entry

56  
00:03:04,460 --> 00:03:02,670  
descent and landing team is charged with

57  
00:03:06,680 --> 00:03:04,470  
getting the rover safely from the

58  
00:03:08,300 --> 00:03:06,690  
with the atmosphere of Mars down to the

59  
00:03:10,490 --> 00:03:08,310  
down to the ground safely

60  
00:03:13,130 --> 00:03:10,500  
that means wheels down on the ground in

61  
00:03:15,050 --> 00:03:13,140  
one piece which means we have to go

62  
00:03:16,430 --> 00:03:15,060  
through a lot of things to get there the

63  
00:03:18,650 --> 00:03:16,440

person you know hidden the atmosphere at

64

00:03:20,450 --> 00:03:18,660

at twelve thirteen thousand miles an

65

00:03:22,130 --> 00:03:20,460

hour and then ending when we touched

66

00:03:28,910 --> 00:03:22,140

down safely at the ground had about

67

00:03:30,590 --> 00:03:28,920

one-and-a-half miles an hour Chloe how

68

00:03:32,540 --> 00:03:30,600

about you what's uh what's your role for

69

00:03:35,350 --> 00:03:32,550

for Mars 2020 specifically systems

70

00:03:38,630 --> 00:03:35,360

engineer well what does that really mean

71

00:03:41,120 --> 00:03:38,640

so like everybody else on our team I do

72

00:03:44,030 --> 00:03:41,130

several different things primarily I'm

73

00:03:46,070 --> 00:03:44,040

the EDL communication systems engineer

74

00:03:48,170 --> 00:03:46,080

which means that I'm responsible for

75

00:03:50,960 --> 00:03:48,180

ensuring that our spacecraft is talking

76  
00:03:53,000 --> 00:03:50,970  
to our orbiters and that the rich set of

77  
00:03:55,790 --> 00:03:53,010  
data that we generate during ETL makes

78  
00:03:57,380 --> 00:03:55,800  
it off of our spacecraft to our orbiters

79  
00:04:00,140 --> 00:03:57,390  
and then through the Deep Space Network

80  
00:04:02,030 --> 00:04:00,150  
and ultimately back to us here at JPL so

81  
00:04:03,560 --> 00:04:02,040  
that we can reconstruct exactly what is

82  
00:04:05,810 --> 00:04:03,570  
happening during media and share it with

83  
00:04:07,520 --> 00:04:05,820  
the world like many other members of my

84  
00:04:08,930 --> 00:04:07,530  
team and also a member of the EDL

85  
00:04:12,470 --> 00:04:08,940  
testing team in the mission system

86  
00:04:15,320 --> 00:04:12,480  
testbed so here we get to dry-run EDL

87  
00:04:17,449 --> 00:04:15,330  
over and over and ensure that our flight

88  
00:04:19,580 --> 00:04:17,459

software is interfacing correctly with

89

00:04:22,159 --> 00:04:19,590

our hardware we essentially get to

90

00:04:24,470 --> 00:04:22,169

practice EDL over and over sometimes in

91

00:04:26,780 --> 00:04:24,480

off nominal situations to ensure that

92

00:04:32,300 --> 00:04:26,790

our flight system is robust to anything

93

00:04:34,909 --> 00:04:32,310

that Mars might throw at it so thinking

94

00:04:36,470 --> 00:04:34,919

about so taking a step back for a second

95

00:04:38,150 --> 00:04:36,480

looking at the big picture here so

96

00:04:40,670 --> 00:04:38,160

obviously we're kind of pinged on kind

97

00:04:42,200 --> 00:04:40,680

of what EDL means and we're what your

98

00:04:44,570 --> 00:04:42,210

roles are but we're talking about

99

00:04:47,060 --> 00:04:44,580

launching what is essentially a small

100

00:04:49,880 --> 00:04:47,070

car the size of a small car anyway it's

101  
00:04:51,200 --> 00:04:49,890  
gonna fly through space to Mars on a

102  
00:04:56,360 --> 00:04:51,210  
journey that takes I think it's eight

103  
00:04:58,640 --> 00:04:56,370  
months to get there okay so seven and a

104  
00:05:00,770 --> 00:04:58,650  
half eight months in that timeframe and

105  
00:05:04,820 --> 00:05:00,780  
so we're trying to slow down enough to

106  
00:05:06,350 --> 00:05:04,830  
land safely so let's talk about where

107  
00:05:08,300 --> 00:05:06,360  
are we gonna land because obviously Mars

108  
00:05:12,010 --> 00:05:08,310  
is not a small place there's lots

109  
00:05:17,130 --> 00:05:12,020  
happening on Mars so where are we going

110  
00:05:21,600 --> 00:05:19,080  
but first friends will landed Deseret

111  
00:05:23,220 --> 00:05:21,610  
crater on marks which I'll can tell you

112  
00:05:25,650 --> 00:05:23,230  
more about how that's such a rich and

113  
00:05:26,850 --> 00:05:25,660

interesting scientific location we're

114

00:05:30,960 --> 00:05:26,860

going to be touching down there on

115

00:05:33,210 --> 00:05:30,970

Thursday February 18th next year 2021 it

116

00:05:35,430 --> 00:05:33,220

will be about 3:30 p.m. East Coast time

117

00:05:37,920 --> 00:05:35,440

12:30 p.m. here in California Oh

118

00:05:45,420 --> 00:05:37,930

incidentally it'll also be 3:30 p.m. at

119

00:05:47,100 --> 00:05:45,430

jezero local the first time so can you

120

00:05:48,540 --> 00:05:47,110

tell us this is what are we seeing in

121

00:05:54,150 --> 00:05:48,550

this picture I know this is from the

122

00:05:56,580 --> 00:05:54,160

Martian surface but what is this Delta

123

00:05:58,920 --> 00:05:56,590

in the middle jezero crater pass

124

00:06:01,560 --> 00:05:58,930

emissions have shown us that Mars in the

125

00:06:03,450 --> 00:06:01,570

past was wet and habitable and had all

126

00:06:05,310 --> 00:06:03,460

the kind of building blocks of life so

127

00:06:07,740 --> 00:06:05,320

Mars 2020 is kind of charged with taking

128

00:06:10,440 --> 00:06:07,750

that next step where you know can we

129

00:06:12,990 --> 00:06:10,450

find the signs of past light at a place

130

00:06:13,980 --> 00:06:13,000

like jezero crater one of the reasons

131

00:06:15,510 --> 00:06:13,990

whether we're going to death row crater

132

00:06:17,220 --> 00:06:15,520

is that is what you're seeing right here

133

00:06:18,930 --> 00:06:17,230

in this picture is a picture of the

134

00:06:21,210 --> 00:06:18,940

Delta that we see here you can kind of

135

00:06:23,400 --> 00:06:21,220

see the the wash where the where the

136

00:06:24,870 --> 00:06:23,410

water may have come into this so this is

137

00:06:28,050 --> 00:06:24,880

create this ancient Delta from the west

138

00:06:29,760 --> 00:06:28,060

side here and then deposit this Delta to

139

00:06:33,180 --> 00:06:29,770

see if the signs of past light we needed

140

00:06:34,770 --> 00:06:33,190

to go to a place that they have might've

141

00:06:36,000 --> 00:06:34,780

had life in the past you know that's not

142

00:06:37,770 --> 00:06:36,010

a first ingredient and the second

143

00:06:40,650 --> 00:06:37,780

question is candidate that have been for

144

00:06:42,180 --> 00:06:40,660

surge preserved over the over the

145

00:06:44,400 --> 00:06:42,190

billions of years so that we can find

146

00:06:45,750 --> 00:06:44,410

the evidence of it now so that's kind of

147

00:06:49,050 --> 00:06:45,760

the reason why we're going to a place

148

00:06:50,220 --> 00:06:49,060

like general crater but the from us from

149

00:06:52,440 --> 00:06:50,230

the from the entry descent and landing

150

00:06:55,470 --> 00:06:52,450

perspective none of that matters that we

151  
00:06:57,450 --> 00:06:55,480  
can't land there safely in fact this

152  
00:06:58,950 --> 00:06:57,460  
site was considered for curiosity

153  
00:07:00,750 --> 00:06:58,960  
actually on Mars Science Laboratory to

154  
00:07:02,790 --> 00:07:00,760  
pass but rejected as being too unsafe

155  
00:07:08,040 --> 00:07:02,800  
but now we think we have the tools to

156  
00:07:10,440 --> 00:07:08,050  
allow us to land there so too unsafe I'm

157  
00:07:14,370 --> 00:07:10,450  
gonna ask that question then if it was

158  
00:07:16,290 --> 00:07:14,380  
too unsafe for curiosity then what gives

159  
00:07:18,030 --> 00:07:16,300  
you the confidence and I believe that we

160  
00:07:19,290 --> 00:07:18,040  
can do it obviously you guys are the

161  
00:07:21,030 --> 00:07:19,300  
experts you know what you're doing

162  
00:07:24,450 --> 00:07:21,040  
so how are we so confident that we can

163  
00:07:26,160 --> 00:07:24,460

do that today well we're looking for

164

00:07:27,420 --> 00:07:26,170

land site we have to make sure of a few

165

00:07:29,010 --> 00:07:27,430

things right there to make sure that we

166

00:07:30,760 --> 00:07:29,020

command there safely we're trying to

167

00:07:32,200 --> 00:07:30,770

make sure that site isn't too high

168

00:07:34,870 --> 00:07:32,210

the atmosphere of Mars is really thin

169

00:07:36,249 --> 00:07:34,880

and we use it to stop so if we go to a

170

00:07:38,200 --> 00:07:36,259

site that's really high we have less

171

00:07:39,580 --> 00:07:38,210

atmosphere to use to stop less stopping

172

00:07:41,170 --> 00:07:39,590

power that's kind of the first thing we

173

00:07:43,240 --> 00:07:41,180

look for the second thing we're looking

174

00:07:44,499 --> 00:07:43,250

for is the atmosphere we don't want to

175

00:07:46,390 --> 00:07:44,509

go to a place where the weather is bad

176

00:07:48,670 --> 00:07:46,400

where there can be a lot of wind shears

177

00:07:49,990 --> 00:07:48,680

or unpredictable weather so that's

178

00:07:52,029 --> 00:07:50,000

something that we're also screening

179

00:07:53,559 --> 00:07:52,039

landing sites for and thirdly

180

00:07:56,020 --> 00:07:53,569

we have to make sure that the terrain

181

00:07:57,490 --> 00:07:56,030

itself is safe enough to land on in the

182

00:07:59,830 --> 00:07:57,500

past we've tried to make sure that faces

183

00:08:01,480 --> 00:07:59,840

but we could land on were kind of as

184

00:08:05,080 --> 00:08:01,490

parking lot as possible right we want to

185

00:08:07,240 --> 00:08:05,090

land in the in Flat Rock three places

186

00:08:08,620 --> 00:08:07,250

kind of like runways right that that

187

00:08:11,760 --> 00:08:08,630

make it easy for us to put the rover

188

00:08:14,920 --> 00:08:11,770

right down on its wheels but while while

189

00:08:16,480 --> 00:08:14,930

perseverance here looks a lot like Mars

190

00:08:19,029 --> 00:08:16,490

tweak or looks a lot like curiosity from

191

00:08:20,589 --> 00:08:19,039

the outside and the UDL system looks

192

00:08:22,240 --> 00:08:20,599

great similar we've added a couple of

193

00:08:24,659 --> 00:08:22,250

things that will help us land land

194

00:08:28,059 --> 00:08:27,010

Chloe can probably talk through the how

195

00:08:29,469 --> 00:08:28,069

we get through from the top the

196

00:08:31,300 --> 00:08:29,479

atmosphere to the bottom then I'll talk

197

00:08:33,610 --> 00:08:31,310

a little bit about how we've added a few

198

00:08:36,519 --> 00:08:33,620

things to make a place like Jess or a

199

00:08:37,810 --> 00:08:36,529

possible yeah Chloe as you kind of talk

200

00:08:40,149 --> 00:08:37,820

through that process of kind of from the

201  
00:08:41,649 --> 00:08:40,159  
atmosphere to the the surface there we

202  
00:08:44,769 --> 00:08:41,659  
had a question come in on social on the

203  
00:08:46,840 --> 00:08:44,779  
chat window actually asking are you

204  
00:08:49,329 --> 00:08:46,850  
tracking real-time data what's that

205  
00:08:50,740 --> 00:08:49,339  
process like for understanding at this

206  
00:08:54,269 --> 00:08:50,750  
very moment what's happening during the

207  
00:08:58,690 --> 00:08:54,279  
EDL process so happy to hear your answer

208  
00:09:00,880 --> 00:08:58,700  
yeah so first to summarize what the EDL

209  
00:09:03,250 --> 00:09:00,890  
process looks like like al alluded to

210  
00:09:05,500 --> 00:09:03,260  
earlier as he mentioned we hit the

211  
00:09:08,560 --> 00:09:05,510  
atmosphere at a screaming velocity going

212  
00:09:10,660 --> 00:09:08,570  
about 5.5 to 5.6 kilometers per second

213  
00:09:13,420 --> 00:09:10,670

or maybe more attractable number 12 to

214

00:09:15,040 --> 00:09:13,430

13,000 miles per hour we use the

215

00:09:17,139 --> 00:09:15,050

atmosphere to start slowing down

216

00:09:19,720 --> 00:09:17,149

protected by our heat shield otherwise

217

00:09:22,780 --> 00:09:19,730

we burn up while we're steering towards

218

00:09:25,180 --> 00:09:22,790

our target using Apollo adaptive guided

219

00:09:26,980 --> 00:09:25,190

entry and then we deployed the largest

220

00:09:29,710 --> 00:09:26,990

supersonic planetary parachute that has

221

00:09:31,780 --> 00:09:29,720

ever been used it's about 21 and a half

222

00:09:35,740 --> 00:09:31,790

meters in diameter and we'll deploy that

223

00:09:37,389 --> 00:09:35,750

at a Mach of around 1.75 and then we

224

00:09:40,060 --> 00:09:37,399

slow down a little bit we jettison our

225

00:09:41,890 --> 00:09:40,070

heat shield around Mach 0.7 uncovering

226

00:09:43,269 --> 00:09:41,900

the radar which we can use to start

227

00:09:45,910 --> 00:09:43,279

searching for the ground

228

00:09:48,639 --> 00:09:45,920

and then at that point our descent stage

229

00:09:50,439 --> 00:09:48,649

drops out of the backshell execute the

230

00:09:52,300 --> 00:09:50,449

divert maneuver so that it doesn't

231

00:09:54,129 --> 00:09:52,310

recontact the backshell and the

232

00:09:55,960 --> 00:09:54,139

parachute that's still attached and then

233

00:10:00,129 --> 00:09:55,970

the descent stage takes us down to the

234

00:10:01,840 --> 00:10:00,139

velocity of only 0.75 meters per second

235

00:10:04,299 --> 00:10:01,850

at just about 20 meters off of the

236

00:10:06,009 --> 00:10:04,309

ground in shoes where we execute the sky

237

00:10:08,319 --> 00:10:06,019

crane maneuver that was originally

238

00:10:10,540 --> 00:10:08,329

debuted on curiosity which separates the

239

00:10:12,999 --> 00:10:10,550

rover from the descent stage like a

240

00:10:15,220 --> 00:10:13,009

rocket jetpack and touches perseverance

241

00:10:18,069 --> 00:10:15,230

down safely and slowly on her wheels and

242

00:10:20,710 --> 00:10:18,079

then we separate the descent stage and

243

00:10:22,809 --> 00:10:20,720

fly it away to a safe distance and all

244

00:10:25,600 --> 00:10:22,819

throughout that process we can't really

245

00:10:27,009 --> 00:10:25,610

joystick it or RC it here on earth we

246

00:10:29,019 --> 00:10:27,019

can't control it at all because at that

247

00:10:31,239 --> 00:10:29,029

point the one-way light time between

248

00:10:33,369 --> 00:10:31,249

Earth and Mars is over ten minutes so

249

00:10:36,369 --> 00:10:33,379

the best we can do is set perseverance

250

00:10:38,319 --> 00:10:36,379

up to safely fly EDL all by herself but

251  
00:10:39,670 --> 00:10:38,329  
we are receiving telemetry that's

252  
00:10:41,920 --> 00:10:39,680  
real-time to us throughout that whole

253  
00:10:43,210 --> 00:10:41,930  
process that mission controlling you

254  
00:10:44,679 --> 00:10:43,220  
figure out what's happening and

255  
00:10:46,900 --> 00:10:44,689  
specifically I think the person online

256  
00:10:49,240 --> 00:10:46,910  
asked about Amaro's involvement does

257  
00:10:50,980 --> 00:10:49,250  
that data come via MRO which is the Mars

258  
00:10:52,900 --> 00:10:50,990  
Reconnaissance Orbiter or other

259  
00:10:56,049 --> 00:10:52,910  
satellites that we have on mars or is it

260  
00:10:58,059 --> 00:10:56,059  
coming straight back to us we are

261  
00:11:00,160 --> 00:10:58,069  
definitely using MRO as one of our

262  
00:11:02,559 --> 00:11:00,170  
partner or ruse to relay that data yeah

263  
00:11:03,490 --> 00:11:02,569

cool we had another question come in I

264

00:11:05,160 --> 00:11:03,500

don't know if either of you can answer

265

00:11:07,600 --> 00:11:05,170

this but curious to know if you know

266

00:11:09,129 --> 00:11:07,610

there was a really cool piece done for

267

00:11:11,110 --> 00:11:09,139

curiosity's landing called the seven

268

00:11:12,429 --> 00:11:11,120

minutes of Terror kind of alluding to

269

00:11:14,889 --> 00:11:12,439

what you just mentioned Chloe the idea

270

00:11:16,809 --> 00:11:14,899

that we can't control it we've just set

271

00:11:18,850 --> 00:11:16,819

it up for success which is kind of a

272

00:11:21,369 --> 00:11:18,860

cool like really terrifying reality

273

00:11:22,569 --> 00:11:21,379

hence the seven minutes of Terror are we

274

00:11:25,119 --> 00:11:22,579

gonna have another piece like that to

275

00:11:25,869 --> 00:11:25,129

kind of talk about what's different this

276

00:11:27,249 --> 00:11:25,879

time around

277

00:11:28,900 --> 00:11:27,259

obviously there's hopefully a little

278

00:11:32,919 --> 00:11:28,910

less terror because we've done it once

279

00:11:35,619 --> 00:11:32,929

really successfully yeah we definitely

280

00:11:37,240 --> 00:11:35,629

added a few things here that are a

281

00:11:38,439 --> 00:11:37,250

little bit more terrifying certainly the

282

00:11:40,569 --> 00:11:38,449

sight is more challenging than we've

283

00:11:42,340 --> 00:11:40,579

gone to that but you're right we have a

284

00:11:44,319 --> 00:11:42,350

little bit more confidence from from the

285

00:11:45,549 --> 00:11:44,329

past mission from curiosity and we have

286

00:11:47,949 --> 00:11:45,559

a lot of inheritance from that mission

287

00:11:50,019 --> 00:11:47,959

that make us confident that we're gonna

288

00:11:51,610 --> 00:11:50,029

make it successfully but we've added a

289

00:11:53,590 --> 00:11:51,620

couple of tools within after descent

290

00:11:55,900 --> 00:11:53,600

landing itself to make our ride

291

00:11:56,889 --> 00:11:55,910

hopefully a little bit safer and help us

292

00:11:58,590 --> 00:11:56,899

land and

293

00:12:01,119 --> 00:11:58,600

the use of gnarly places like Jazz Row

294

00:12:03,100 --> 00:12:01,129

one is a range trigger this is the

295

00:12:05,799 --> 00:12:03,110

ability to deploy the parachute based on

296

00:12:09,519 --> 00:12:05,809

navigated range this helps to shrink the

297

00:12:10,780 --> 00:12:09,529

area that we might land on curiosity we

298

00:12:12,850 --> 00:12:10,790

deployed the parachute based on just

299

00:12:14,679 --> 00:12:12,860

hitting the particular navigated Wasi

300

00:12:16,720 --> 00:12:14,689

when you get to that velocity deploy the

301  
00:12:18,249 --> 00:12:16,730  
parachute in factory assi actually knew

302  
00:12:19,629 --> 00:12:18,259  
it was a little bit long of where we

303  
00:12:23,019 --> 00:12:19,639  
intended to deploy the parachute but

304  
00:12:25,449 --> 00:12:23,029  
that ik wander along so this time we're

305  
00:12:27,129 --> 00:12:25,459  
giving perseverance the ability to to

306  
00:12:28,960 --> 00:12:27,139  
figure out where it is on the way in and

307  
00:12:30,669 --> 00:12:28,970  
deploy the parachute based on hitting

308  
00:12:32,379 --> 00:12:30,679  
the actual position that we wanted to

309  
00:12:34,419 --> 00:12:32,389  
play the parachute app that helps us

310  
00:12:35,980 --> 00:12:34,429  
shrink down the area and help us fit our

311  
00:12:39,429 --> 00:12:35,990  
landing ellipses into a much smaller

312  
00:12:40,449 --> 00:12:39,439  
tighter spots like Jesu and second we've

313  
00:12:42,730 --> 00:12:40,459

added something called terrain wealth

314

00:12:44,319 --> 00:12:42,740

and navigation that allows us to take

315

00:12:45,939 --> 00:12:44,329

pictures on the way down which we kind

316

00:12:47,230 --> 00:12:45,949

of did on on curiosity we kind of took

317

00:12:49,269 --> 00:12:47,240

those pictures kind of like a tourist

318

00:12:51,160 --> 00:12:49,279

who didn't really and put together a

319

00:12:53,139 --> 00:12:51,170

movie but didn't really use those in the

320

00:12:54,759 --> 00:12:53,149

landing process this time on the way

321

00:12:56,259 --> 00:12:54,769

down while we're under parachute once

322

00:12:57,429 --> 00:12:56,269

the each Hill has come off we'll be

323

00:12:59,949 --> 00:12:57,439

taking pictures of the ground and

324

00:13:00,970 --> 00:12:59,959

matching them up to an on board map it's

325

00:13:02,860 --> 00:13:00,980

kind of like you where I if we go out

326

00:13:04,540 --> 00:13:02,870

driving right you can hold your map in

327

00:13:05,679 --> 00:13:04,550

your hand and take a look around and see

328

00:13:06,519 --> 00:13:05,689

it the different landmarks that are out

329

00:13:08,410 --> 00:13:06,529

there and figure out where you are

330

00:13:10,689 --> 00:13:08,420

that's what we're asking perseverance to

331

00:13:12,519 --> 00:13:10,699

do on the way down so that once it's

332

00:13:14,049 --> 00:13:12,529

figured out figures out where it is it

333

00:13:16,199 --> 00:13:14,059

can use the propulsive part of entry

334

00:13:18,610 --> 00:13:16,209

descent landing to fly to safe spots

335

00:13:20,169 --> 00:13:18,620

what that means is we no longer need the

336

00:13:22,960 --> 00:13:20,179

entire area in which we could come down

337

00:13:24,280 --> 00:13:22,970

to be a flat and boring parking lot we

338

00:13:26,439 --> 00:13:24,290

can have lots of little small parking

339

00:13:28,989 --> 00:13:26,449

lots nearby and have hazardous things

340

00:13:30,340 --> 00:13:28,999

and in the vicinity if you go back to

341

00:13:31,989 --> 00:13:30,350

that picture of Jays row you can see

342

00:13:34,720 --> 00:13:31,999

that we're targeting the ellipse

343

00:13:36,970 --> 00:13:34,730

directly on the edge of that Delta which

344

00:13:39,100 --> 00:13:36,980

is about a 16 80 meter tall clippings

345

00:13:41,110 --> 00:13:39,110

and it's also filled with rocks to the

346

00:13:42,789 --> 00:13:41,120

east and craters and other places where

347

00:13:44,679 --> 00:13:42,799

we don't want to drive that Rover and

348

00:13:46,660 --> 00:13:44,689

the only reason this is okay is because

349

00:13:49,059 --> 00:13:46,670

as we have shrunk that landing list to

350

00:13:50,799 --> 00:13:49,069

make it much smaller and B have put this

351  
00:13:52,150 --> 00:13:50,809  
terrain relative navigation system in so

352  
00:13:53,559 --> 00:13:52,160  
that we can find those little parking

353  
00:13:55,509 --> 00:13:53,569  
lots that are interspersed around these

354  
00:13:58,090 --> 00:13:55,519  
hazards you know there's always that

355  
00:13:59,919 --> 00:13:58,100  
tension between science and engineering

356  
00:14:01,780 --> 00:13:59,929  
from the landing side we want to land in

357  
00:14:04,030 --> 00:14:01,790  
as flat as boring places as possible so

358  
00:14:05,769 --> 00:14:04,040  
they're safe but places that the

359  
00:14:07,449 --> 00:14:05,779  
scientists want to go you know are like

360  
00:14:09,100 --> 00:14:07,459  
the Grand Canyon or like just wrote here

361  
00:14:11,210 --> 00:14:09,110  
where we have lots of terrain and lots

362  
00:14:13,070 --> 00:14:11,220  
of rocks to look at lots of

363  
00:14:15,440 --> 00:14:13,080

so we found a way to balance those

364

00:14:16,640 --> 00:14:15,450

things by adding some capability to our

365

00:14:18,140 --> 00:14:16,650

entry descent landing system that

366

00:14:21,470 --> 00:14:18,150

originated on curiosity has been

367

00:14:22,760 --> 00:14:21,480

upgraded for Mars 2020 it's awesome we

368

00:14:24,830 --> 00:14:22,770

had a question come in don't know if you

369

00:14:35,660 --> 00:14:24,840

know this but are there 3d printed parts

370

00:14:39,110 --> 00:14:35,670

on perseverance there see if I can I can

371

00:14:40,280 --> 00:14:39,120

name some no that's all right it's a big

372

00:14:41,510 --> 00:14:40,290

Rover and one of the things to to kind

373

00:14:44,120 --> 00:14:41,520

of point out about 3d printing in

374

00:14:45,530 --> 00:14:44,130

general is that for things that are the

375

00:14:47,330 --> 00:14:45,540

the machines that are more common they

376

00:14:49,760 --> 00:14:47,340

print with a much more plastic II

377

00:14:51,230 --> 00:14:49,770

material but there are 3d printers that

378

00:14:53,930 --> 00:14:51,240

have the ability to print with much

379

00:14:55,700 --> 00:14:53,940

greater levels of strength of composite

380

00:14:57,320 --> 00:14:55,710

so we're not necessarily indicating that

381

00:14:58,610 --> 00:14:57,330

there's plastic pieces on there that

382

00:15:00,350 --> 00:14:58,620

might be as fragile as what you could do

383

00:15:01,730 --> 00:15:00,360

in your house there's some pretty high

384

00:15:03,860 --> 00:15:01,740

fidelity stuff some things that can even

385

00:15:05,540 --> 00:15:03,870

include Kevlar these days so pretty

386

00:15:07,970 --> 00:15:05,550

awesome there but what ask you both

387

00:15:09,710 --> 00:15:07,980

we're winding down here on time but what

388

00:15:12,380 --> 00:15:09,720

are your roles gonna be for launch and

389

00:15:13,790 --> 00:15:12,390

landing obviously for landing you guys

390

00:15:15,740 --> 00:15:13,800

have critical roles to play because

391

00:15:16,220 --> 00:15:15,750

that's really your bread and butter but

392

00:15:17,570 --> 00:15:16,230

for launch

393

00:15:21,470 --> 00:15:17,580

are you just spectating or you just

394

00:15:24,140 --> 00:15:21,480

enjoying that moment I think for lunch

395

00:15:27,740 --> 00:15:24,150

yeah most of us will just be in the

396

00:15:29,060 --> 00:15:27,750

sunshine and waving goodbye to the thing

397

00:15:31,820 --> 00:15:29,070

that many of us have spent a long time

398

00:15:33,980 --> 00:15:31,830

on a few members of our team are working

399

00:15:35,210 --> 00:15:33,990

some aspects at lunch but for entry

400

00:15:39,980 --> 00:15:35,220

descent and landing like you said our

401  
00:15:41,570 --> 00:15:39,990  
big days ever 18 20 21 so for that like

402  
00:15:44,060 --> 00:15:41,580  
I mentioned earlier there's nothing we

403  
00:15:45,800 --> 00:15:44,070  
can do really to control EDL the days

404  
00:15:47,060 --> 00:15:45,810  
leading up to ETL are very important

405  
00:15:48,860 --> 00:15:47,070  
because we want to ensure that we've

406  
00:15:50,870 --> 00:15:48,870  
configured the spacecraft so that she

407  
00:15:52,460 --> 00:15:50,880  
can fly the safest DDL possible so make

408  
00:15:54,530 --> 00:15:52,470  
sure that she has all the updated

409  
00:15:56,960 --> 00:15:54,540  
navigation and trajectory information

410  
00:15:58,400 --> 00:15:56,970  
that she would need but when it gets to

411  
00:15:59,900 --> 00:15:58,410  
the actual event we'll all just be in

412  
00:16:01,730 --> 00:15:59,910  
the Mission Control rooms at JPL

413  
00:16:03,500 --> 00:16:01,740

monitoring that telemetry stream and

414

00:16:11,570 --> 00:16:03,510

sharing what we've learned with the rest

415

00:16:13,310 --> 00:16:11,580

of the world I'll hover for you yeah I

416

00:16:15,230 --> 00:16:13,320

mean that looking back and remember what

417

00:16:16,460 --> 00:16:15,240

I did for the Curiosity watch I think

418

00:16:18,650 --> 00:16:16,470

that was the last vacation I took before

419

00:16:21,230 --> 00:16:18,660

landing so hopefully we'll be on

420

00:16:22,640 --> 00:16:21,240

vacation you'll see the launch and then

421

00:16:24,110 --> 00:16:22,650

you know back to the grindstone

422

00:16:25,700 --> 00:16:24,120

make sure that we do everything

423

00:16:28,460 --> 00:16:25,710

that's that we can to make sure that we

424

00:16:31,100 --> 00:16:28,470

have a good day home decorating yeah

425

00:16:33,590 --> 00:16:31,110

obviously two big dates to mark their

426

00:16:35,480 --> 00:16:33,600

July 17th is what we're targeting as our

427

00:16:37,100 --> 00:16:35,490

launch date I'm charging ahead stolen

428

00:16:42,560 --> 00:16:37,110

time and then you said landing was

429

00:16:44,030 --> 00:16:42,570

February what 18 February 18th okay and

430

00:16:45,710 --> 00:16:44,040

if you haven't seen it the landing

431

00:16:48,050 --> 00:16:45,720

footage from curiosity from the control

432

00:16:49,670 --> 00:16:48,060

room is pretty spectacular it's kind of

433

00:16:51,320 --> 00:16:49,680

the world championship of robotics and

434

00:16:53,600 --> 00:16:51,330

engineering I'm getting to see that

435

00:16:56,180 --> 00:16:53,610

thing come together so well though for

436

00:16:57,620 --> 00:16:56,190

both of you cheering this time in a very

437

00:17:01,730 --> 00:16:57,630

excited fashion once we get confirmation

438

00:17:05,540 --> 00:17:01,740

that we're on the ground safely Thanks

439

00:17:07,040 --> 00:17:05,550

there's like Reierson plastic all right

440

00:17:09,770 --> 00:17:07,050

i'll Chloe appreciate you both thanks

441

00:17:12,740 --> 00:17:09,780

for joining me thanks for having us John

442

00:17:14,090 --> 00:17:12,750

success all right so we are just about

443

00:17:16,220 --> 00:17:14,100

time like I said please feel free to

444

00:17:17,689 --> 00:17:16,230

continue to submit questions for us also

445

00:17:19,370 --> 00:17:17,699

please let us know what you like to see

446

00:17:22,160 --> 00:17:19,380

on future episodes subscribe to our

447

00:17:24,260 --> 00:17:22,170

Channel and wanted to highlight really

448

00:17:26,780 --> 00:17:24,270

quickly for you obviously there's a lot

449

00:17:29,240 --> 00:17:26,790

happening with NASA at home it is a big

450

00:17:30,440 --> 00:17:29,250

effort of just lots of things you can do

451  
00:17:32,060 --> 00:17:30,450  
if you're at home and you need things to

452  
00:17:34,220 --> 00:17:32,070  
look at really cool ebooks and videos

453  
00:17:35,510 --> 00:17:34,230  
and all sorts of other things also be

454  
00:17:40,070 --> 00:17:35,520  
sure to check out more about Mars 2020

455  
00:17:43,880 --> 00:17:40,080  
at Mars nasa.gov slash Mars 2020 and I

456  
00:17:46,430 --> 00:17:43,890  
want to call attention to what is the

457  
00:17:48,560 --> 00:17:46,440  
the social media highlight of this week

458  
00:17:50,030 --> 00:17:48,570  
no question there's a lot going on on

459  
00:17:53,600 --> 00:17:50,040  
social media but this is the biggest

460  
00:17:55,190 --> 00:17:53,610  
thing we have the launch of humans from

461  
00:17:57,049 --> 00:17:55,200  
America to low-earth orbit for the first

462  
00:18:00,500 --> 00:17:57,059  
time since the retirement of the space

463  
00:18:03,650 --> 00:18:00,510

shuttle program so Bob ethnic and Doug

464

00:18:07,760 --> 00:18:03,660

Hurley will be flying on May 27th aboard

465

00:18:10,280 --> 00:18:07,770

a falcon 9 and crew dragon headed to the

466

00:18:12,200 --> 00:18:10,290

International Space Station so we could

467

00:18:13,220 --> 00:18:12,210

not be more excited for this this is the

468

00:18:15,799 --> 00:18:13,230

culmination of the Commercial Crew

469

00:18:17,299 --> 00:18:15,809

program so very excited to see that

470

00:18:19,490 --> 00:18:17,309

happening that's gonna do it for us

471

00:18:21,980 --> 00:18:19,500

today I'm Joshua Santora usually from

472

00:18:23,419 --> 00:18:21,990

the Kennedy Space Center hoping to see

473

00:18:25,580 --> 00:18:23,429

you again later this week where we kind

474

00:18:27,320 --> 00:18:25,590

of recap our veggie episode so hopefully

475

00:18:29,000 --> 00:18:27,330

you you're growing your popcorn check

476

00:18:31,100 --> 00:18:29,010

out our episode on plant growth to learn

477

00:18:33,140 --> 00:18:31,110

more about that I'll have my popcorn

478

00:18:34,370 --> 00:18:33,150

ready I'm gonna reveal it live I haven't

479

00:18:35,419 --> 00:18:34,380

looked at it so I'm excited to see where

480

00:18:37,550 --> 00:18:35,429

it where it's headed and where it's

481

00:18:40,130 --> 00:18:37,560

going but that's all for today