
CHARLES ELACHI MISSION CONTROL CENTER
DATA CONTROLLER
DEEP SPACE NETWORK
DATA CONTROLLER
OPERATIONS CHIEF

1
00:05:45,830 --> 00:05:43,909
as the countdown to mars continues

2
00:05:47,909 --> 00:05:45,840
the perseverance of humanity launching

3
00:06:00,450 --> 00:05:47,919
the next generation of robotic explorers

4
00:06:00,460 --> 00:06:29,909
[Music]

5
00:06:34,710 --> 00:06:31,990
welcome to nasa's jet propulsion

6
00:06:36,230 --> 00:06:34,720
laboratory in southern california

7
00:06:39,510 --> 00:06:36,240
we are gearing up for nasa's

8
00:06:41,830 --> 00:06:39,520
perseverance rover to touch down on mars

9
00:06:43,590 --> 00:06:41,840
happening in an hour and a half from now

10
00:06:45,990 --> 00:06:43,600
the rover will attempt to land

11
00:06:48,070 --> 00:06:46,000
in jezreel crater it is the most

12
00:06:51,270 --> 00:06:48,080
difficult landing site on mars

13
00:06:54,469 --> 00:06:51,280

ever attempted thank you for joining us

14
00:06:56,629 --> 00:06:54,479
i'm your host raquel villanueva

15
00:06:58,309 --> 00:06:56,639
in the past mission team members

16
00:06:59,430 --> 00:06:58,319
gathered in our mission control for

17
00:07:01,749 --> 00:06:59,440
landings

18
00:07:03,589 --> 00:07:01,759
but this time around we have coveted

19
00:07:05,270 --> 00:07:03,599
safety measures in place

20
00:07:07,350 --> 00:07:05,280
today's landing will look a little

21
00:07:10,070 --> 00:07:07,360
different than what you've seen before

22
00:07:11,350 --> 00:07:10,080
i am in a room by myself and so is my

23
00:07:13,430 --> 00:07:11,360
co-host

24
00:07:15,909 --> 00:07:13,440
here in the space flight operations

25
00:07:17,430 --> 00:07:15,919
facility team members are in different

26
00:07:20,150 --> 00:07:17,440
parts of this building

27
00:07:21,189 --> 00:07:20,160
some are in mission control others are

28
00:07:24,629 --> 00:07:21,199
upstairs for

29
00:07:25,350 --> 00:07:24,639
landing operations we also have isolated

30
00:07:28,469 --> 00:07:25,360
rooms for

31
00:07:29,670 --> 00:07:28,479
our guests on the show in total we have

32
00:07:32,469 --> 00:07:29,680
eight locations

33
00:07:33,830 --> 00:07:32,479
covered by 14 robotic cameras that you

34
00:07:36,870 --> 00:07:33,840
will be seeing

35
00:07:40,309 --> 00:07:36,880
one of those locations is the dark room

36
00:07:42,830 --> 00:07:40,319
the heart of nasa's deep space network

37
00:07:44,390 --> 00:07:42,840
think of it as a giant communication

38
00:07:46,869 --> 00:07:44,400

switchboard this

39
00:07:48,710 --> 00:07:46,879
is where spacecraft phone home to us

40
00:07:51,670 --> 00:07:48,720
from across the solar system

41
00:07:53,830 --> 00:07:51,680
and interstellar space the deep space

42
00:07:57,270 --> 00:07:53,840
network has been tracking perseverance

43
00:07:59,909 --> 00:07:57,280
since it left earth and there are lots

44
00:08:02,950 --> 00:07:59,919
of ways you can watch landing today

45
00:08:05,430 --> 00:08:02,960
we have a 360 degree camera

46
00:08:06,790 --> 00:08:05,440
inside the control room it lets you

47
00:08:08,710 --> 00:08:06,800
experience the landing

48
00:08:10,150 --> 00:08:08,720
right along with the team while seeing

49
00:08:13,430 --> 00:08:10,160
this broadcast

50
00:08:16,150 --> 00:08:13,440
we also have the clean feed it shows an

51
00:08:17,749 --> 00:08:16,160
uninterrupted view of mission control

52
00:08:21,270 --> 00:08:17,759
and audio

53
00:08:23,430 --> 00:08:21,280
dambien de nemo's program in espanol

54
00:08:24,390 --> 00:08:23,440
to tell us about it is host diana

55
00:08:27,990 --> 00:08:24,400
trujillo

56
00:08:32,310 --> 00:08:30,070
thank you raquel we're so excited to be

57
00:08:33,269 --> 00:08:32,320
the sister live broadcast in spanish

58
00:08:37,389 --> 00:08:33,279
synthony

59
00:08:52,790 --> 00:08:37,399
program twitter youtube and facebook and

60
00:08:56,710 --> 00:08:55,030
and don't forget we want to see how you

61
00:08:59,190 --> 00:08:56,720
are watching the landing today

62
00:09:00,790 --> 00:08:59,200
use the countdown to mars to send us

63
00:09:03,110 --> 00:09:00,800

your photos and videos

64
00:09:05,990 --> 00:09:03,120
to preview what interviews are coming up

65
00:09:09,670 --> 00:09:06,000
is my co-host from the jpl news office

66
00:09:11,829 --> 00:09:09,680
marina jericho thanks so much raquel

67
00:09:13,829 --> 00:09:11,839
the excitement is building behind me

68
00:09:16,470 --> 00:09:13,839
right here in mission control as we

69
00:09:18,550 --> 00:09:16,480
count down to the perseverance landing

70
00:09:20,710 --> 00:09:18,560
we will be talking to some of the many

71
00:09:23,910 --> 00:09:20,720
people who made today possible from

72
00:09:25,350 --> 00:09:23,920
scientist to engineers on the mars 2020

73
00:09:27,269 --> 00:09:25,360
perseverance rover team

74
00:09:28,790 --> 00:09:27,279
to folks from nasa headquarters giving

75
00:09:31,509 --> 00:09:28,800
us a look into the future

76
00:09:33,350 --> 00:09:31,519
of mars exploration a little later we

77
00:09:34,550 --> 00:09:33,360
will also be speaking with the students

78
00:09:37,590 --> 00:09:34,560
who named the rover

79
00:09:38,710 --> 00:09:37,600
and the helicopter inspirational stories

80
00:09:41,750 --> 00:09:38,720
as we prepare for

81
00:09:45,110 --> 00:09:41,760
another landing on the red planet

82
00:09:47,030 --> 00:09:45,120
back to you raquel on this exciting day

83
00:09:48,389 --> 00:09:47,040
later in the show we will be answering

84
00:09:50,870 --> 00:09:48,399
some of the questions you

85
00:09:52,070 --> 00:09:50,880
submitted through your classrooms

86
00:09:55,269 --> 00:09:52,080
landing on mars

87
00:09:57,190 --> 00:09:55,279
is complex on this exciting day

88
00:09:59,110 --> 00:09:57,200

later in the show we will be answering

89
00:10:01,030 --> 00:09:59,120
some of the questions you submitted

90
00:10:04,630 --> 00:10:01,040
through your classrooms

91
00:10:07,030 --> 00:10:04,640
landing on mars is complex the team will

92
00:10:09,430 --> 00:10:07,040
be calling out milestones as they happen

93
00:10:10,790 --> 00:10:09,440
it's fast-paced and you'll hear lots of

94
00:10:12,870 --> 00:10:10,800
technical terms

95
00:10:15,030 --> 00:10:12,880
to help us translate and explain what is

96
00:10:17,590 --> 00:10:15,040
going on in mission control

97
00:10:19,750 --> 00:10:17,600
is swati mohan she is part of

98
00:10:21,269 --> 00:10:19,760
perseverance's landing team

99
00:10:23,910 --> 00:10:21,279
thanks for guiding us through landing

100
00:10:24,949 --> 00:10:23,920
today swati hi raquel i'm happy to be

101
00:10:27,110 --> 00:10:24,959
here today

102
00:10:29,030 --> 00:10:27,120
so swati what is the status of the

103
00:10:31,350 --> 00:10:29,040
perseverance rover right now

104
00:10:32,389 --> 00:10:31,360
so perseverance is still in space right

105
00:10:35,670 --> 00:10:32,399
now about

106
00:10:39,590 --> 00:10:35,680
9 000 miles from mars so far

107
00:10:40,710 --> 00:10:39,600
so mars is about 127 million miles from

108
00:10:43,110 --> 00:10:40,720
earth right now

109
00:10:43,829 --> 00:10:43,120
that means it takes about 11 minutes

110
00:10:53,269 --> 00:10:43,839
from

111
00:10:54,069 --> 00:10:53,279
that means it takes about 11 minutes

112
00:11:00,310 --> 00:10:54,079
from

113
00:11:02,230 --> 00:11:00,320

earth so all the information that we

114
00:11:02,949 --> 00:11:02,240
receive from perseverance actually

115
00:11:06,389 --> 00:11:02,959
happened

116
00:11:09,430 --> 00:11:06,399
11 minutes ago so the round trip

117
00:11:10,790 --> 00:11:09,440
is 22 minutes for us to send a command

118
00:11:13,509 --> 00:11:10,800
to perseverance

119
00:11:14,630 --> 00:11:13,519
and hear back on the ground that she's

120
00:11:17,670 --> 00:11:14,640
received that command

121
00:11:20,150 --> 00:11:17,680
this is what we call two-way light time

122
00:11:21,910 --> 00:11:20,160
that's good to know and can you tell us

123
00:11:22,949 --> 00:11:21,920
who else is in the room with you right

124
00:11:25,269 --> 00:11:22,959
now

125
00:11:26,550 --> 00:11:25,279
the operations team is split into two

126
00:11:28,949 --> 00:11:26,560
different areas

127
00:11:30,310 --> 00:11:28,959
here in the cruise mission support area

128
00:11:32,470 --> 00:11:30,320
we have primarily

129
00:11:33,750 --> 00:11:32,480
the team that has been flying

130
00:11:37,030 --> 00:11:33,760
perseverance from

131
00:11:37,910 --> 00:11:37,040
earth to mars you'll see the placards

132
00:11:40,150 --> 00:11:37,920
with the

133
00:11:41,190 --> 00:11:40,160
roles of each of the people by their

134
00:11:43,590 --> 00:11:41,200
stations

135
00:11:44,710 --> 00:11:43,600
some of the people you may hear talking

136
00:11:47,590 --> 00:11:44,720
today are

137
00:11:48,069 --> 00:11:47,600
the flight director who is the conductor

138
00:11:51,110 --> 00:11:48,079

of our

139
00:11:52,629 --> 00:11:51,120
operations orchestra here the entry

140
00:11:55,590 --> 00:11:52,639
descent and landing

141
00:11:56,550 --> 00:11:55,600
activity lead who is a member of the

142
00:11:58,949 --> 00:11:56,560
landing team

143
00:12:00,870 --> 00:11:58,959
tasked with understanding the execution

144
00:12:03,750 --> 00:12:00,880
of entry descent and landing

145
00:12:04,710 --> 00:12:03,760
and then also the telecommunications and

146
00:12:07,430 --> 00:12:04,720
entry descent

147
00:12:09,590 --> 00:12:07,440
and landing communications engineers who

148
00:12:11,430 --> 00:12:09,600
will be monitoring the signal from

149
00:12:12,710 --> 00:12:11,440
perseverance through the different paths

150
00:12:16,230 --> 00:12:12,720
that we have

151
00:12:18,629 --> 00:12:16,240
upstairs in what we call the war room

152
00:12:19,670 --> 00:12:18,639
we have almost the entire entry descent

153
00:12:22,550 --> 00:12:19,680
and landing

154
00:12:23,190 --> 00:12:22,560
operations team and then across the hall

155
00:12:25,910 --> 00:12:23,200
from them

156
00:12:26,310 --> 00:12:25,920
we have this surface mission control

157
00:12:28,870 --> 00:12:26,320
room

158
00:12:29,350 --> 00:12:28,880
where the surface operations team is

159
00:12:30,949 --> 00:12:29,360
ready

160
00:12:33,829 --> 00:12:30,959
and waiting to take over as soon as

161
00:12:36,949 --> 00:12:33,839
perseverance's wheels touch the ground

162
00:12:39,509 --> 00:12:36,959
and you have been part of this mission

163
00:12:40,949 --> 00:12:39,519

for years now can you tell us what have

164
00:12:42,949 --> 00:12:40,959
you been working on

165
00:12:45,030 --> 00:12:42,959
i've been working on perseverance for

166
00:12:48,150 --> 00:12:45,040
almost eight years now

167
00:12:51,110 --> 00:12:48,160
as a guidance navigation control

168
00:12:52,230 --> 00:12:51,120
engineer working primarily on entry

169
00:12:55,190 --> 00:12:52,240
descent and landing

170
00:12:55,990 --> 00:12:55,200
one of my big tasks was to help with

171
00:12:58,550 --> 00:12:56,000
terrain

172
00:13:00,470 --> 00:12:58,560
relative navigation perseverance will be

173
00:13:02,069 --> 00:13:00,480
the first mission to fly terrain

174
00:13:03,829 --> 00:13:02,079
relative navigation

175
00:13:05,269 --> 00:13:03,839
so while she's descending on the

176
00:13:08,150 --> 00:13:05,279
parachute she will

177
00:13:09,110 --> 00:13:08,160
actually be looking at the ground with a

178
00:13:10,949 --> 00:13:09,120
camera

179
00:13:12,389 --> 00:13:10,959
seeing where she is with respect to the

180
00:13:15,350 --> 00:13:12,399
martian surface and

181
00:13:16,389 --> 00:13:15,360
choosing a safe spot to land that she

182
00:13:18,550 --> 00:13:16,399
can get to

183
00:13:19,750 --> 00:13:18,560
after so many years of working on the

184
00:13:21,590 --> 00:13:19,760
mission it's

185
00:13:22,949 --> 00:13:21,600
an honor to be here today as the mission

186
00:13:24,310 --> 00:13:22,959
commentator

187
00:13:26,470 --> 00:13:24,320
we're happy to have you here thanks

188
00:13:28,949 --> 00:13:26,480

swati we'll be checking back in with you

189
00:13:31,350 --> 00:13:28,959
in just a few minutes as perseverance

190
00:13:34,069 --> 00:13:31,360
approaches its next milestone

191
00:13:35,110 --> 00:13:34,079
but for now let's learn more about the

192
00:13:40,069 --> 00:13:35,120
rover's mission

193
00:13:44,870 --> 00:13:42,710
you know mars is the closest place that

194
00:13:46,629 --> 00:13:44,880
we can reach with robotic exploration

195
00:13:48,230 --> 00:13:46,639
that we think had a really good chance

196
00:13:50,470 --> 00:13:48,240
of having ancient life

197
00:13:52,550 --> 00:13:50,480
the perseverance rover will land at a

198
00:13:54,629 --> 00:13:52,560
location called jezreel crater

199
00:13:56,310 --> 00:13:54,639
jezreel crater is a very interesting

200
00:13:58,389 --> 00:13:56,320
place it's a crater

201
00:13:59,350 --> 00:13:58,399
that once held a lake there are a lot of

202
00:14:01,189 --> 00:13:59,360
craters on

203
00:14:02,790 --> 00:14:01,199
the surface of mars that could have once

204
00:14:04,629 --> 00:14:02,800
hosted ancient lakes

205
00:14:06,949 --> 00:14:04,639
but not every crater that we think had a

206
00:14:08,230 --> 00:14:06,959
lake actually preserves evidence that

207
00:14:10,150 --> 00:14:08,240
that lake was there

208
00:14:12,150 --> 00:14:10,160
it had an inflow channel and it had an

209
00:14:13,670 --> 00:14:12,160
outflow channel that means it was filled

210
00:14:16,069 --> 00:14:13,680
the crater was filled

211
00:14:18,069 --> 00:14:16,079
with water in jezreel we have probably

212
00:14:19,590 --> 00:14:18,079
one of the most beautifully preserved

213
00:14:22,150 --> 00:14:19,600

delta deposits

214
00:14:23,509 --> 00:14:22,160
on mars in that crater this is a

215
00:14:25,829 --> 00:14:23,519
wonderful place to live

216
00:14:26,790 --> 00:14:25,839
for microorganisms and it is also a

217
00:14:29,670 --> 00:14:26,800
wonderful place

218
00:14:30,949 --> 00:14:29,680
for those microorganisms to be preserved

219
00:14:33,030 --> 00:14:30,959
so that we can find them

220
00:14:34,790 --> 00:14:33,040
now so many billions of years later

221
00:14:36,069 --> 00:14:34,800
there is no other place on mars that has

222
00:14:38,150 --> 00:14:36,079
the unique combination

223
00:14:39,110 --> 00:14:38,160
of a lake setting a beautifully

224
00:14:40,790 --> 00:14:39,120
preserved delta

225
00:14:42,629 --> 00:14:40,800
and the diverse mineralogy that we have

226
00:14:43,430 --> 00:14:42,639
in jezreel crater so it's truly a

227
00:14:46,550 --> 00:14:43,440
special

228
00:14:47,750 --> 00:14:46,560
landing site the major goal of the

229
00:14:51,269 --> 00:14:47,760
perseverance mission

230
00:14:52,550 --> 00:14:51,279
is to investigate astrobiology on mars

231
00:14:54,310 --> 00:14:52,560
and in particular

232
00:14:55,590 --> 00:14:54,320
to address the question of whether life

233
00:14:58,389 --> 00:14:55,600
ever existed

234
00:14:59,750 --> 00:14:58,399
on mars the perseverance rover starts

235
00:15:01,910 --> 00:14:59,760
with a design that's very similar to

236
00:15:03,829 --> 00:15:01,920
curiosity but we've added to it a whole

237
00:15:05,430 --> 00:15:03,839
new set of science instruments

238
00:15:07,110 --> 00:15:05,440

and these science instruments were

239
00:15:08,949 --> 00:15:07,120
purposefully selected

240
00:15:10,710 --> 00:15:08,959
to help us in the search for

241
00:15:12,949 --> 00:15:10,720
biosignatures

242
00:15:13,750 --> 00:15:12,959
we're going to be taking microphones

243
00:15:16,629 --> 00:15:13,760
with us

244
00:15:17,910 --> 00:15:16,639
for the first time we're going to have

245
00:15:21,110 --> 00:15:17,920
that human sense

246
00:15:23,430 --> 00:15:21,120
on another planet perseverance

247
00:15:24,150 --> 00:15:23,440
carries with her a grand experiment in

248
00:15:27,269 --> 00:15:24,160
space

249
00:15:28,150 --> 00:15:27,279
fairing technology a helicopter the name

250
00:15:30,790 --> 00:15:28,160
of which

251
00:15:32,790 --> 00:15:30,800
is now ingenuity one of the major

252
00:15:34,870 --> 00:15:32,800
upgrades that perseverance has

253
00:15:36,069 --> 00:15:34,880
from curiosity is that it's able to

254
00:15:38,870 --> 00:15:36,079
self-drive

255
00:15:39,590 --> 00:15:38,880
for a distance of up to 200 meters per

256
00:15:41,910 --> 00:15:39,600
day

257
00:15:43,189 --> 00:15:41,920
as the rover is driving it's literally

258
00:15:46,470 --> 00:15:43,199
building the map

259
00:15:48,470 --> 00:15:46,480
of the road it's driving on on mars

260
00:15:50,629 --> 00:15:48,480
scientists for years have told us that

261
00:15:52,389 --> 00:15:50,639
to really unlock

262
00:15:54,550 --> 00:15:52,399
the secrets of mars we have to bring

263
00:15:58,310 --> 00:15:54,560

samples from mars back to earth

264
00:16:01,749 --> 00:15:58,320
so what marsh 2020 is going to do is to

265
00:16:03,350 --> 00:16:01,759
drill samples put them in small tubes

266
00:16:05,350 --> 00:16:03,360
we're going to seal it in its own

267
00:16:05,990 --> 00:16:05,360
individual tube we set them on the

268
00:16:08,150 --> 00:16:06,000
surface

269
00:16:09,189 --> 00:16:08,160
to provide a target for the second two

270
00:16:11,110 --> 00:16:09,199
missions

271
00:16:12,470 --> 00:16:11,120
which hopefully will get in development

272
00:16:14,230 --> 00:16:12,480
in the next several years and could

273
00:16:18,389 --> 00:16:14,240
potentially get the samples back

274
00:16:19,110 --> 00:16:18,399
to earth by 2031. perseverance is a very

275
00:16:22,310 --> 00:16:19,120
very

276
00:16:25,430 --> 00:16:22,320
profound first step in both

277
00:16:28,470 --> 00:16:25,440
our understanding of our place

278
00:16:35,990 --> 00:16:28,480
in the universe and a stepping stone

279
00:16:38,310 --> 00:16:36,000
towards human exploration on mars

280
00:16:39,110 --> 00:16:38,320
you are watching live mars landing

281
00:16:40,949 --> 00:16:39,120
commentary

282
00:16:43,030 --> 00:16:40,959
and perseverance is about to reach

283
00:16:45,670 --> 00:16:43,040
another important milestone

284
00:16:46,150 --> 00:16:45,680
swati can you tell us what is happening

285
00:16:49,269 --> 00:16:46,160
we are

286
00:16:51,910 --> 00:16:49,279
at a milestone where the operations team

287
00:16:54,310 --> 00:16:51,920
determines whether they're ready to turn

288
00:16:56,629 --> 00:16:54,320

off the transmitter to perseverance

289
00:16:57,430 --> 00:16:56,639
turning off the transmitter is like

290
00:16:59,910 --> 00:16:57,440
taking

291
00:17:01,990 --> 00:16:59,920
your hands off of the wheel at this

292
00:17:04,789 --> 00:17:02,000
point ford perseverance would be

293
00:17:06,230 --> 00:17:04,799
on her own to execute entry descent and

294
00:17:13,590 --> 00:17:06,240
landing over 500

295
00:17:18,150 --> 00:17:15,590
okay all stations we are ready for the

296
00:17:23,350 --> 00:17:18,160
transmitter off poll

297
00:17:30,870 --> 00:17:27,350
acs are you go hcs we go

298
00:17:34,470 --> 00:17:30,880
phase two phase two is go

299
00:17:39,029 --> 00:17:34,480
activity activities go help link lead

300
00:17:49,350 --> 00:17:42,950
edl com go telecom one

301
00:17:56,070 --> 00:17:52,630
go gds2 go

302
00:17:59,110 --> 00:17:56,080
fault protection go power

303
00:18:02,230 --> 00:17:59,120
go avionics go

304
00:18:06,150 --> 00:18:02,240
thermal go flight software

305
00:18:09,669 --> 00:18:06,160
please go for go data management go

306
00:18:12,870 --> 00:18:09,679
propulsion go art lead

307
00:18:17,350 --> 00:18:12,880
go team chief go

308
00:18:20,789 --> 00:18:17,360
ace go launch cruise phase lead

309
00:18:23,830 --> 00:18:20,799
go deputy mission go

310
00:18:27,270 --> 00:18:23,840
edl phase lead go mission

311
00:18:32,470 --> 00:18:27,280
assurance assurances go chief

312
00:18:39,750 --> 00:18:36,070
chief is go project manager

313
00:18:42,549 --> 00:18:39,760

project go mission manager all stations

314
00:18:47,110 --> 00:18:42,559
are go for transmitter off

315
00:18:50,150 --> 00:18:49,270
there you have it raquel we have deemed

316
00:18:52,150 --> 00:18:50,160
perseverance

317
00:18:54,710 --> 00:18:52,160
ready to execute entry descent and

318
00:18:56,789 --> 00:18:54,720
landing on her own

319
00:18:58,070 --> 00:18:56,799
thank you swati as we just heard

320
00:19:00,549 --> 00:18:58,080
perseverance is now

321
00:19:02,150 --> 00:19:00,559
operating on its own as it cruises

322
00:19:04,230 --> 00:19:02,160
closer to mars

323
00:19:05,510 --> 00:19:04,240
to help explain what this mission means

324
00:19:08,230 --> 00:19:05,520
for the agency

325
00:19:09,510 --> 00:19:08,240
is nasa's associate administrator thomas

326
00:19:12,070 --> 00:19:09,520
zurbukin

327
00:19:14,310 --> 00:19:12,080
thomas this is our fifth rover sent to

328
00:19:16,070 --> 00:19:14,320
mars since 1997.

329
00:19:18,710 --> 00:19:16,080
can you tell us how perseverance is

330
00:19:20,950 --> 00:19:18,720
going to kick-start a new era

331
00:19:22,870 --> 00:19:20,960
wow this is such an important date today

332
00:19:23,990 --> 00:19:22,880
and and it really is the beginning of a

333
00:19:26,630 --> 00:19:24,000
new era in a sense

334
00:19:27,590 --> 00:19:26,640
that we're going from exploration kind

335
00:19:31,110 --> 00:19:27,600
of with

336
00:19:34,630 --> 00:19:31,120
experiments on rovers looking around

337
00:19:35,830 --> 00:19:34,640
doing analysis to the sample return

338
00:19:38,630 --> 00:19:35,840

phase in which we're

339
00:19:39,590 --> 00:19:38,640
not only looking around looking at the

340
00:19:42,310 --> 00:19:39,600
geology

341
00:19:44,789 --> 00:19:42,320
but really turning our rower into a

342
00:19:48,390 --> 00:19:44,799
robotic geologist and astrobiologist

343
00:19:50,470 --> 00:19:48,400
collecting samples that we will bring

344
00:19:52,549 --> 00:19:50,480
back to earth and for us of course those

345
00:19:54,630 --> 00:19:52,559
are where the best laboratories are

346
00:19:56,630 --> 00:19:54,640
of all of humanity some of them still

347
00:19:57,350 --> 00:19:56,640
remain to be explored by some that are

348
00:19:59,830 --> 00:19:57,360
not yet

349
00:20:01,510 --> 00:19:59,840
in the science community yet and that's

350
00:20:02,789 --> 00:20:01,520
what we're looking forward to it's that

351
00:20:04,870 --> 00:20:02,799
new face the other

352
00:20:06,710 --> 00:20:04,880
element that i want to talk about is the

353
00:20:08,789 --> 00:20:06,720
amazing technologies that are there and

354
00:20:11,430 --> 00:20:08,799
of course one of my favorites is the

355
00:20:13,510 --> 00:20:11,440
ingenuity helicopter this in search of

356
00:20:14,470 --> 00:20:13,520
this extraterrestrial wright brothers

357
00:20:16,630 --> 00:20:14,480
moment you know

358
00:20:18,470 --> 00:20:16,640
controlled flight for the first time

359
00:20:21,590 --> 00:20:18,480
elsewhere raquel

360
00:20:25,190 --> 00:20:21,600
great and we have a student question on

361
00:20:28,549 --> 00:20:25,200
video for you from macy

362
00:20:31,669 --> 00:20:28,559
hi my name is macy ragsdale my question

363
00:20:35,430 --> 00:20:31,679

is is anything alive on mars

364
00:20:36,950 --> 00:20:35,440
thank you well amazing i'm so glad

365
00:20:39,350 --> 00:20:36,960
for your question that's a question i

366
00:20:39,990 --> 00:20:39,360
ask myself is anything alive there and

367
00:20:41,750 --> 00:20:40,000
frankly

368
00:20:43,750 --> 00:20:41,760
at the surface where we're going right

369
00:20:47,190 --> 00:20:43,760
now with uh perseverance

370
00:20:48,789 --> 00:20:47,200
we do not believe there's anything alive

371
00:20:50,470 --> 00:20:48,799
right there because of the radiation

372
00:20:52,390 --> 00:20:50,480
that's there it's chilling cold and

373
00:20:53,270 --> 00:20:52,400
there's really no water there but guess

374
00:20:56,070 --> 00:20:53,280
what

375
00:20:56,630 --> 00:20:56,080
we think that three billion years ago

376
00:20:58,710 --> 00:20:56,640
this

377
00:21:01,029 --> 00:20:58,720
looked like a stream that you may see on

378
00:21:02,870 --> 00:21:01,039
earth and frankly a lot more similar

379
00:21:04,390 --> 00:21:02,880
than earth with water with a magnetic

380
00:21:07,669 --> 00:21:04,400
field just like the earth with an

381
00:21:09,510 --> 00:21:07,679
atmosphere and the question was

382
00:21:10,789 --> 00:21:09,520
at that time three billion years ago

383
00:21:12,789 --> 00:21:10,799
were there

384
00:21:14,549 --> 00:21:12,799
single cell organisms just of the type

385
00:21:16,870 --> 00:21:14,559
that developed on earth so

386
00:21:18,470 --> 00:21:16,880
is there life on on mars overall we

387
00:21:19,830 --> 00:21:18,480
don't know but where we're going right

388
00:21:21,510 --> 00:21:19,840

now we're really looking for

389
00:21:23,590 --> 00:21:21,520
ancient life and that's what we're so

390
00:21:26,070 --> 00:21:23,600
excited about

391
00:21:26,710 --> 00:21:26,080
thank you for your time today thomas and

392
00:21:29,029 --> 00:21:26,720
thanks to

393
00:21:30,710 --> 00:21:29,039
everyone who has been using the hashtag

394
00:21:33,110 --> 00:21:30,720
countdown to mars

395
00:21:36,310 --> 00:21:33,120
here are some of the photos that you've

396
00:21:39,750 --> 00:21:36,320
sent in so far let's take a look

397
00:21:45,830 --> 00:21:39,760
now please keep sharing with us how

398
00:21:48,630 --> 00:21:45,840
you are watching this moment today

399
00:21:50,630 --> 00:21:48,640
for now let's go back to swati for an

400
00:21:53,430 --> 00:21:50,640
important update to what's going on

401
00:21:55,669 --> 00:21:53,440
in mission control as we get closer to

402
00:21:58,390 --> 00:21:55,679
another milestone

403
00:21:59,909 --> 00:21:58,400
hi raquel this next milestone is a

404
00:22:02,789 --> 00:21:59,919
communications poll

405
00:22:03,750 --> 00:22:02,799
so during landing not only will

406
00:22:06,870 --> 00:22:03,760
perseverance

407
00:22:08,789 --> 00:22:06,880
talk directly to earth but we'll also be

408
00:22:09,750 --> 00:22:08,799
talking to two spacecraft that are

409
00:22:12,070 --> 00:22:09,760
currently

410
00:22:13,750 --> 00:22:12,080
orbiting mars the mars reconnaissance

411
00:22:16,789 --> 00:22:13,760
orbiter and the maven

412
00:22:17,909 --> 00:22:16,799
spacecraft this pole is to confirm with

413
00:22:20,230 --> 00:22:17,919

the mars reconnaissance

414
00:22:21,669 --> 00:22:20,240
orbiter spacecraft and the maven

415
00:22:24,789 --> 00:22:21,679
spacecraft teams that they are

416
00:22:26,070 --> 00:22:24,799
ready and on track to support the relay

417
00:22:53,510 --> 00:22:26,080
from perseverance

418
00:22:57,830 --> 00:22:55,510
have you performed the comm check and

419
00:22:59,430 --> 00:22:57,840
readiness of the orbiters

420
00:23:01,590 --> 00:22:59,440
we have performed the voice check and

421
00:23:04,630 --> 00:23:01,600
the readiness poll and can confirm that

422
00:23:06,149 --> 00:23:04,640
mro maven uh eda radio science one and

423
00:23:10,230 --> 00:23:06,159
two uhf dte

424
00:23:18,310 --> 00:23:10,240
dsn and edl gds are all ready to support

425
00:23:23,430 --> 00:23:21,510
so we've just heard that we have

426
00:23:24,870 --> 00:23:23,440
uh confirmation from each of the

427
00:23:26,390 --> 00:23:24,880
different orbiters and

428
00:23:28,310 --> 00:23:26,400
all of their support equipment on the

429
00:23:31,270 --> 00:23:28,320
ground that they are ready

430
00:23:34,870 --> 00:23:31,280
and uh are on track to support the relay

431
00:23:39,190 --> 00:23:37,510
great thank you swati and we just heard

432
00:23:41,190 --> 00:23:39,200
that communications readiness poll which

433
00:23:44,310 --> 00:23:41,200
means we are ready to relay the data

434
00:23:46,789 --> 00:23:44,320
perseverance will send to get a better

435
00:23:48,070 --> 00:23:46,799
idea of what the rover looks like as it

436
00:23:51,350 --> 00:23:48,080
approaches mars

437
00:23:54,070 --> 00:23:51,360
we have a nasa program called eyes

438
00:23:55,669 --> 00:23:54,080

the visualization lets anyone watching

439
00:23:59,269 --> 00:23:55,679
track perseverance

440
00:24:02,549 --> 00:24:01,029
follow perseverance on its journey to

441
00:24:05,350 --> 00:24:02,559
the surface of the red planet

442
00:24:08,430 --> 00:24:05,360
with eyes on the solar system from your

443
00:24:09,909 --> 00:24:08,440
desktop or mobile device go to

444
00:24:12,230 --> 00:24:09,919
eyes.nasa.gov

445
00:24:14,310 --> 00:24:12,240
click on the banner and now you're with

446
00:24:17,350 --> 00:24:14,320
perseverance in real time

447
00:24:20,470 --> 00:24:17,360
through every step of edl entry

448
00:24:21,350 --> 00:24:20,480
descent and landing this interactive

449
00:24:23,110 --> 00:24:21,360
experience

450
00:24:24,870 --> 00:24:23,120
lets you ride along from whatever

451
00:24:28,630 --> 00:24:24,880
perspective you choose

452
00:24:29,909 --> 00:24:28,640
click and drag scroll in scroll out

453
00:24:32,310 --> 00:24:29,919
check out the descriptions and

454
00:24:34,149 --> 00:24:32,320
explanations to increase your edl

455
00:24:36,310 --> 00:24:34,159
expertise

456
00:24:37,350 --> 00:24:36,320
experience every entry descent and

457
00:24:39,990 --> 00:24:37,360
landing event

458
00:24:42,789 --> 00:24:40,000
precisely designed and executed to land

459
00:24:44,630 --> 00:24:42,799
perseverance safely on mars

460
00:24:46,710 --> 00:24:44,640
the i's experience is based on

461
00:24:47,350 --> 00:24:46,720
predictive data but during this

462
00:24:49,430 --> 00:24:47,360
broadcast

463
00:24:50,630 --> 00:24:49,440

you'll see a different visualization

464
00:24:52,870 --> 00:24:50,640
called ranger

465
00:24:54,870 --> 00:24:52,880
and it's based on the real communication

466
00:24:57,909 --> 00:24:54,880
the team and mission control receives

467
00:25:00,070 --> 00:24:57,919
from perseverance in near real time

468
00:25:02,549 --> 00:25:00,080
this is the visualization the team will

469
00:25:04,710 --> 00:25:02,559
follow as data fills their screens while

470
00:25:07,110 --> 00:25:04,720
monitoring the health of perseverance

471
00:25:09,269 --> 00:25:07,120
on its nerve-racking course to another

472
00:25:19,269 --> 00:25:09,279
successful mars landing

473
00:25:22,549 --> 00:25:21,510
you are watching live mars landing

474
00:25:29,510 --> 00:25:22,559
commentary

475
00:25:31,750 --> 00:25:29,520
stepping out

476
00:25:32,870 --> 00:25:31,760
you are watching live mars landing

477
00:25:34,789 --> 00:25:32,880
commentary

478
00:25:36,470 --> 00:25:34,799
stepping outside mission control to talk

479
00:25:39,590 --> 00:25:36,480
to us is perseverance

480
00:25:40,950 --> 00:25:39,600
system engineer matt smith thanks for

481
00:25:43,190 --> 00:25:40,960
joining us today matt

482
00:25:45,029 --> 00:25:43,200
hey raquel well coming from mission

483
00:25:46,470 --> 00:25:45,039
control we are going to hear terms

484
00:25:48,390 --> 00:25:46,480
related to landing

485
00:25:49,750 --> 00:25:48,400
can you help us understand what some of

486
00:25:51,590 --> 00:25:49,760
them mean sure

487
00:25:53,750 --> 00:25:51,600
definitely um one thing you'll hear a

488
00:25:54,710 --> 00:25:53,760

lot about is telemetry so telemetry is

489
00:25:56,070 --> 00:25:54,720
just our way of

490
00:25:57,750 --> 00:25:56,080
talking about data that's coming from

491
00:25:58,549 --> 00:25:57,760
the spacecraft and telling us important

492
00:26:00,789 --> 00:25:58,559
things like

493
00:26:02,390 --> 00:26:00,799
temperatures on the vehicle pressure how

494
00:26:03,110 --> 00:26:02,400
much fuel we have left and other things

495
00:26:05,590 --> 00:26:03,120
that we need to

496
00:26:06,789 --> 00:26:05,600
understand for the health and safety of

497
00:26:08,630 --> 00:26:06,799
the vehicle

498
00:26:09,990 --> 00:26:08,640
you'll also hear the word nominal

499
00:26:12,070 --> 00:26:10,000
hopefully nominal

500
00:26:13,430 --> 00:26:12,080
means everything is expected everything

501
00:26:16,390 --> 00:26:13,440
is okay

502
00:26:16,870 --> 00:26:16,400
we're good to go you'll hear also a lot

503
00:26:19,590 --> 00:26:16,880
about

504
00:26:20,789 --> 00:26:19,600
velocity and deceleration so velocity is

505
00:26:22,870 --> 00:26:20,799
just our speed

506
00:26:24,070 --> 00:26:22,880
combined with the direction we're going

507
00:26:25,990 --> 00:26:24,080
and deceleration

508
00:26:27,269 --> 00:26:26,000
is our slowing velocity so we're coming

509
00:26:29,590 --> 00:26:27,279
in at over 2

510
00:26:30,310 --> 00:26:29,600
12 000 miles per hour and we're going to

511
00:26:32,230 --> 00:26:30,320
slow down

512
00:26:33,350 --> 00:26:32,240
to a nice comfortable 2 miles per hour

513
00:26:35,990 --> 00:26:33,360

at landing

514
00:26:36,630 --> 00:26:36,000
and that's our deceleration speaking of

515
00:26:39,029 --> 00:26:36,640
landing

516
00:26:40,549 --> 00:26:39,039
you may hear a couple important terms at

517
00:26:43,190 --> 00:26:40,559
landing itself

518
00:26:43,669 --> 00:26:43,200
one is remu stable so the remu is a

519
00:26:45,350 --> 00:26:43,679
device

520
00:26:47,350 --> 00:26:45,360
on the rover that measures the rover's

521
00:26:49,750 --> 00:26:47,360
orientation and whether it's moving

522
00:26:51,669 --> 00:26:49,760
so we want a nice stable landing spot

523
00:26:55,590 --> 00:26:51,679
without any motion

524
00:26:57,830 --> 00:26:55,600
you'll also hear uhf stable hopefully

525
00:26:59,990 --> 00:26:57,840
uhf stable refers to good

526
00:27:01,669 --> 00:27:00,000
telecommunications link with the rover

527
00:27:03,110 --> 00:27:01,679
and indicates that we've had a good

528
00:27:05,190 --> 00:27:03,120
separation between

529
00:27:07,029 --> 00:27:05,200
the descent stage and the rover after

530
00:27:09,430 --> 00:27:07,039
the sky crane maneuver

531
00:27:10,070 --> 00:27:09,440
finally you may also hear tango delta

532
00:27:14,149 --> 00:27:10,080
nominal

533
00:27:16,870 --> 00:27:14,159
touched down on the surface of mars

534
00:27:18,389 --> 00:27:16,880
within the expected range of safe

535
00:27:20,630 --> 00:27:18,399
landing speeds

536
00:27:21,590 --> 00:27:20,640
thanks for that breakdown now this is

537
00:27:23,590 --> 00:27:21,600
your first

538
00:27:25,350 --> 00:27:23,600

mars mission what have you learned from

539
00:27:27,269 --> 00:27:25,360
this experience

540
00:27:28,630 --> 00:27:27,279
yeah one of my takeaways is that you can

541
00:27:30,230 --> 00:27:28,640
almost never be too careful when it

542
00:27:31,830 --> 00:27:30,240
comes to mars you definitely can't

543
00:27:33,350 --> 00:27:31,840
take mars for granted you know we've

544
00:27:34,549 --> 00:27:33,360
checked and double checked and triple

545
00:27:37,029 --> 00:27:34,559
checked everything

546
00:27:38,549 --> 00:27:37,039
on our way to mars and um you know even

547
00:27:41,350 --> 00:27:38,559
though we've done this once before

548
00:27:42,870 --> 00:27:41,360
using the uh sky crane technique on the

549
00:27:45,110 --> 00:27:42,880
curiosity rover

550
00:27:46,310 --> 00:27:45,120
um you know i think everyone's gonna

551
00:27:47,590 --> 00:27:46,320
have their uh

552
00:27:48,789 --> 00:27:47,600
everyone's gonna hold their breath until

553
00:27:50,149 --> 00:27:48,799
we're on the surface of mars this time

554
00:27:52,149 --> 00:27:50,159
around

555
00:27:54,389 --> 00:27:52,159
and we have a social media question

556
00:27:57,110 --> 00:27:54,399
coming in nor the door on instagram

557
00:27:58,070 --> 00:27:57,120
asks how complicated is the automated

558
00:28:00,549 --> 00:27:58,080
landing sequence

559
00:28:01,990 --> 00:28:00,559
and who wrote the code yeah it's quite

560
00:28:04,710 --> 00:28:02,000
complicated uh the automated

561
00:28:06,230 --> 00:28:04,720
landing software needs to do literally

562
00:28:08,230 --> 00:28:06,240
hundreds of things

563
00:28:10,549 --> 00:28:08,240

all on its own just right with

564
00:28:13,029 --> 00:28:10,559
sub-second timing accuracy

565
00:28:13,750 --> 00:28:13,039
and it's the result of many hundreds of

566
00:28:15,110 --> 00:28:13,760
people

567
00:28:17,029 --> 00:28:15,120
over many years stretching all the way

568
00:28:19,029 --> 00:28:17,039
back to curiosity and then

569
00:28:21,350 --> 00:28:19,039
improved for the perseverance landing

570
00:28:23,029 --> 00:28:21,360
today at jezreel crater

571
00:28:25,350 --> 00:28:23,039
great thanks for your time today matt

572
00:28:28,549 --> 00:28:25,360
and good luck thanks

573
00:28:29,990 --> 00:28:28,559
now landing on mars is hard landing on

574
00:28:32,149 --> 00:28:30,000
mars during a pandemic is

575
00:28:34,070 --> 00:28:32,159
even harder the team behind the

576
00:28:36,549 --> 00:28:34,080
perseverance rover faced one of its

577
00:28:37,909 --> 00:28:36,559
biggest challenges when the coronavirus

578
00:28:44,800 --> 00:28:37,919
pandemic struck

579
00:28:48,389 --> 00:28:44,810
here's how they kept the mission going

580
00:28:51,990 --> 00:28:48,399
[Music]

581
00:28:53,830 --> 00:28:52,000
when the pandemic struck the future was

582
00:28:55,750 --> 00:28:53,840
certainly unknown it was like walking

583
00:28:57,510 --> 00:28:55,760
into a blind dark alley you didn't know

584
00:29:01,110 --> 00:28:57,520
what was there what was in front of you

585
00:29:04,870 --> 00:29:03,110
it's something that nobody expected it's

586
00:29:06,789 --> 00:29:04,880
something nobody could plan for

587
00:29:08,549 --> 00:29:06,799
we all were asked to start working from

588
00:29:09,110 --> 00:29:08,559

home rather than your first priority

589
00:29:12,149 --> 00:29:09,120
being

590
00:29:13,029 --> 00:29:12,159
mission success and and getting to the

591
00:29:14,549 --> 00:29:13,039
launch pad

592
00:29:16,310 --> 00:29:14,559
your first priority immediately gets

593
00:29:18,310 --> 00:29:16,320
displaced and it's now

594
00:29:19,830 --> 00:29:18,320
the safety of the people and it took a

595
00:29:20,630 --> 00:29:19,840
lot of work to put stuff together in

596
00:29:22,630 --> 00:29:20,640
order to

597
00:29:24,870 --> 00:29:22,640
keep momentum going to keep people

598
00:29:26,310 --> 00:29:24,880
working safely keep them healthy and to

599
00:29:28,230 --> 00:29:26,320
keep the project

600
00:29:29,830 --> 00:29:28,240
on schedule we called the effort march

601
00:29:32,950 --> 00:29:29,840
2020 safe at work

602
00:29:36,149 --> 00:29:32,960
and the objective was to keep the team

603
00:29:37,909 --> 00:29:36,159
as safe or safer than they would be

604
00:29:39,350 --> 00:29:37,919
if they were not working you know

605
00:29:40,789 --> 00:29:39,360
putting a spacecraft together that's

606
00:29:43,110 --> 00:29:40,799
going to mars

607
00:29:44,549 --> 00:29:43,120
and not making a mistake it's hard no

608
00:29:45,830 --> 00:29:44,559
matter what

609
00:29:49,510 --> 00:29:45,840
trying to do it during the middle of the

610
00:29:52,789 --> 00:29:49,520
pandemic it's it's a lot harder

611
00:29:53,750 --> 00:29:52,799
and liftoff as the countdown to mars

612
00:29:55,669 --> 00:29:53,760
continues

613
00:29:57,750 --> 00:29:55,679

the perseverance of humanity launching

614
00:29:59,510 --> 00:29:57,760
the next generation of robotic explorers

615
00:30:01,029 --> 00:29:59,520
to the red planet

616
00:30:02,710 --> 00:30:01,039
certainly never done something like this

617
00:30:04,310 --> 00:30:02,720
before try to lead a team that's flying

618
00:30:06,070 --> 00:30:04,320
a spacecraft on the way to mars

619
00:30:08,549 --> 00:30:06,080
while getting ready for landing while

620
00:30:12,389 --> 00:30:08,559
doing it all from home there's no doubt

621
00:30:15,590 --> 00:30:12,399
that working in isolation

622
00:30:17,510 --> 00:30:15,600
not virtual isolation but in physical

623
00:30:20,710 --> 00:30:17,520
isolation from everyone else

624
00:30:23,990 --> 00:30:20,720
is a challenge we had to

625
00:30:27,350 --> 00:30:24,000
rethink and redesign what it meant to

626
00:30:29,909 --> 00:30:27,360
operate a spacecraft in

627
00:30:32,070 --> 00:30:29,919
flight when we couldn't all be in the

628
00:30:34,149 --> 00:30:32,080
same room in mission control

629
00:30:35,110 --> 00:30:34,159
seeing the data come down from

630
00:30:36,950 --> 00:30:35,120
perseverance

631
00:30:38,789 --> 00:30:36,960
it was a major change going to that you

632
00:30:39,990 --> 00:30:38,799
know looking at everyone on a screen

633
00:30:42,630 --> 00:30:40,000
instead of in person

634
00:30:44,710 --> 00:30:42,640
because of the pandemic you can't uh you

635
00:30:46,230 --> 00:30:44,720
know just pop over your cubicle wall and

636
00:30:47,269 --> 00:30:46,240
talk to the person next to you

637
00:30:49,350 --> 00:30:47,279
it's definitely been a challenge to

638
00:30:50,389 --> 00:30:49,360

figure out how to communicate and get

639
00:30:52,389 --> 00:30:50,399
everything done

640
00:30:53,669 --> 00:30:52,399
remotely but we've managed to make it

641
00:30:56,710 --> 00:30:53,679
work we are

642
00:30:59,430 --> 00:30:56,720
explorers our job is to go

643
00:31:00,630 --> 00:30:59,440
into the unknown and this is just

644
00:31:03,830 --> 00:31:00,640
another example

645
00:31:04,630 --> 00:31:03,840
of the unknown we're really doing

646
00:31:06,710 --> 00:31:04,640
something

647
00:31:07,909 --> 00:31:06,720
that's transformative and trying to

648
00:31:10,070 --> 00:31:07,919
understand whether or not

649
00:31:11,909 --> 00:31:10,080
life evolved on another planet that's

650
00:31:12,710 --> 00:31:11,919
the fundamental objective of this

651
00:31:15,190 --> 00:31:12,720
mission

652
00:31:15,909 --> 00:31:15,200
we're all still connected by this

653
00:31:18,149 --> 00:31:15,919
incredible

654
00:31:19,509 --> 00:31:18,159
mission and this this wonderful team

655
00:31:20,630 --> 00:31:19,519
that we have the opportunity to be a

656
00:31:23,430 --> 00:31:20,640
part of so

657
00:31:25,190 --> 00:31:23,440
that keeps at least me going pretty much

658
00:31:27,430 --> 00:31:25,200
everybody that i've talked to

659
00:31:28,789 --> 00:31:27,440
that's associated with the mission has

660
00:31:30,630 --> 00:31:28,799
has said the same thing

661
00:31:33,350 --> 00:31:30,640
which is you could not have come up with

662
00:31:35,750 --> 00:31:33,360
a better name than perseverance

663
00:31:36,630 --> 00:31:35,760

it's an amazing serendipity that we get

664
00:31:47,740 --> 00:31:36,640
to persevere

665
00:31:59,990 --> 00:31:47,750
through working on perseverance

666
00:32:03,509 --> 00:32:02,470
joining us now is perseverance deputy

667
00:32:07,110 --> 00:32:03,519
project manager

668
00:32:08,070 --> 00:32:07,120
matt wallace matt just how ambitious is

669
00:32:10,149 --> 00:32:08,080
this mission

670
00:32:11,190 --> 00:32:10,159
and how was the perseverance team able

671
00:32:13,350 --> 00:32:11,200
to stay on track

672
00:32:15,269 --> 00:32:13,360
with unexpected challenges like the

673
00:32:17,990 --> 00:32:15,279
pandemic

674
00:32:19,430 --> 00:32:18,000
well it's a very ambitious mission you

675
00:32:22,950 --> 00:32:19,440
know we're carrying not only

676
00:32:25,830 --> 00:32:22,960
a host of new uh extremely capable

677
00:32:27,590 --> 00:32:25,840
science instruments to do that that

678
00:32:28,549 --> 00:32:27,600
science mission that we've talked about

679
00:32:31,029 --> 00:32:28,559
but also

680
00:32:32,789 --> 00:32:31,039
a number of technology experiments will

681
00:32:35,590 --> 00:32:32,799
provide feed forward

682
00:32:37,669 --> 00:32:35,600
information into the next set of robotic

683
00:32:38,870 --> 00:32:37,679
explorers or even human exploration of

684
00:32:41,110 --> 00:32:38,880
mars

685
00:32:42,789 --> 00:32:41,120
so there's a lot for us to do we look a

686
00:32:43,269 --> 00:32:42,799
lot like curiosity but in fact we're

687
00:32:46,310 --> 00:32:43,279
carrying

688
00:32:47,990 --> 00:32:46,320

50 percent more payload down to the

689
00:32:51,029 --> 00:32:48,000
surface of mars

690
00:32:53,110 --> 00:32:51,039
and so it is a it's been a big challenge

691
00:32:54,950 --> 00:32:53,120
um you know and it was particularly

692
00:32:57,750 --> 00:32:54,960
challenging when the pandemic

693
00:33:00,389 --> 00:32:57,760
struck it came at a critical time in our

694
00:33:03,190 --> 00:33:00,399
processing we were just months away

695
00:33:04,870 --> 00:33:03,200
from launching we were trying to

696
00:33:06,950 --> 00:33:04,880
essentially

697
00:33:08,070 --> 00:33:06,960
get the spacecraft assembled and do the

698
00:33:10,230 --> 00:33:08,080
final tests

699
00:33:11,190 --> 00:33:10,240
we did not have a lot of margin in our

700
00:33:14,310 --> 00:33:11,200
schedule

701
00:33:15,029 --> 00:33:14,320
and our focus just entirely shifted from

702
00:33:17,269 --> 00:33:15,039
that

703
00:33:19,669 --> 00:33:17,279
to keeping the team safe and keeping

704
00:33:21,350 --> 00:33:19,679
their families safe

705
00:33:23,430 --> 00:33:21,360
and we had to do that quickly we had to

706
00:33:25,350 --> 00:33:23,440
make that adjustment quickly

707
00:33:26,710 --> 00:33:25,360
i think uh you know we got through it

708
00:33:27,430 --> 00:33:26,720
with a lot of help a lot of people

709
00:33:29,269 --> 00:33:27,440
stepped up

710
00:33:30,470 --> 00:33:29,279
uh to make it happen the team was

711
00:33:32,389 --> 00:33:30,480
tenacious

712
00:33:35,190 --> 00:33:32,399
uh and we managed to get it launched and

713
00:33:37,269 --> 00:33:35,200

and fly it to mars it's

714
00:33:38,950 --> 00:33:37,279
you know thanks to a lot of help and

715
00:33:42,149 --> 00:33:38,960
matt just how large

716
00:33:45,110 --> 00:33:42,159
is the team that worked on perseverance

717
00:33:46,789 --> 00:33:45,120
it's a big team a couple thousand people

718
00:33:49,990 --> 00:33:46,799
here just at jpl

719
00:33:53,029 --> 00:33:50,000
in fact have worked on on this mission

720
00:33:54,070 --> 00:33:53,039
and then almost every other nasa center

721
00:33:56,789 --> 00:33:54,080
has contributed

722
00:33:57,750 --> 00:33:56,799
in some significant and critical way as

723
00:34:01,110 --> 00:33:57,760
well

724
00:34:02,870 --> 00:34:01,120
uh we have um over a thousand

725
00:34:05,430 --> 00:34:02,880
industry partners that have provided

726
00:34:08,869 --> 00:34:05,440
hardware into this mission from

727
00:34:10,310 --> 00:34:08,879
44 different states 560 different cities

728
00:34:12,230 --> 00:34:10,320
and of course we have international

729
00:34:14,230 --> 00:34:12,240
contributions from europe

730
00:34:15,270 --> 00:34:14,240
and many other international providers

731
00:34:17,909 --> 00:34:15,280
as well so

732
00:34:19,030 --> 00:34:17,919
it's a it's a big team it's taken a lot

733
00:34:22,149 --> 00:34:19,040
of people to get us

734
00:34:24,550 --> 00:34:22,159
to where we're at that is a big team

735
00:34:25,510 --> 00:34:24,560
this is the most difficult landing site

736
00:34:27,190 --> 00:34:25,520
ever attempted

737
00:34:30,550 --> 00:34:27,200
now why do you think perseverance is

738
00:34:32,470 --> 00:34:30,560

ready to land in jezreel crater now

739
00:34:34,310 --> 00:34:32,480
jezreel is tough i mean it's

740
00:34:35,829 --> 00:34:34,320
scientifically fascinating

741
00:34:38,790 --> 00:34:35,839
because it's got a lot of things like

742
00:34:41,669 --> 00:34:38,800
craters and uh

743
00:34:42,550 --> 00:34:41,679
you know rock fields and cliffs and sand

744
00:34:44,550 --> 00:34:42,560
dunes and

745
00:34:46,389 --> 00:34:44,560
that sort of thing which are great for

746
00:34:47,990 --> 00:34:46,399
the science community that's exactly the

747
00:34:50,310 --> 00:34:48,000
type of features they're looking for

748
00:34:52,069 --> 00:34:50,320
to learn more about mars but they're all

749
00:34:54,470 --> 00:34:52,079
any hazards for us

750
00:34:55,349 --> 00:34:54,480
and so we've had to add some new

751
00:34:57,270 --> 00:34:55,359
technology

752
00:34:59,109 --> 00:34:57,280
uh terrain relative navigation which is

753
00:35:00,470 --> 00:34:59,119
the ability essentially to divert away

754
00:35:03,030 --> 00:35:00,480
from hazards

755
00:35:03,510 --> 00:35:03,040
uh and but we have taken this system

756
00:35:05,510 --> 00:35:03,520
through

757
00:35:07,750 --> 00:35:05,520
the same types of paces that we have on

758
00:35:11,109 --> 00:35:07,760
previous missions we've used the same

759
00:35:13,109 --> 00:35:11,119
techniques the same uh best practices

760
00:35:15,270 --> 00:35:13,119
for engineering verification

761
00:35:16,870 --> 00:35:15,280
and in many cases we've used the same

762
00:35:19,109 --> 00:35:16,880
people this in fact is my

763
00:35:20,390 --> 00:35:19,119

my fifth mars rover mission and i'm not

764
00:35:21,990 --> 00:35:20,400
alone there's other people on the

765
00:35:25,430 --> 00:35:22,000
project in the same

766
00:35:26,230 --> 00:35:25,440
in the same situation so um you know the

767
00:35:29,430 --> 00:35:26,240
team has

768
00:35:32,069 --> 00:35:29,440
given it everything they've gotten to

769
00:35:33,430 --> 00:35:32,079
put it all put it all out there and uh

770
00:35:34,470 --> 00:35:33,440
to make this successful and i think

771
00:35:36,069 --> 00:35:34,480
we're ready

772
00:35:38,150 --> 00:35:36,079
thanks matt and good luck on your fifth

773
00:35:40,550 --> 00:35:38,160
mission thank you very much

774
00:35:43,030 --> 00:35:40,560
well jezreel crater is a location on

775
00:35:43,990 --> 00:35:43,040
mars that has intrigued scientists for

776
00:35:45,829 --> 00:35:44,000
years

777
00:35:47,430 --> 00:35:45,839
let's head over to marina to learn more

778
00:35:51,349 --> 00:35:47,440
about the science goals

779
00:35:53,990 --> 00:35:51,359
of the mission that's right raquel

780
00:35:55,910 --> 00:35:54,000
here to explain why we want to go there

781
00:35:59,990 --> 00:35:55,920
is deputy project scientist

782
00:36:02,069 --> 00:36:00,000
katie stack morgan welcome katie

783
00:36:03,990 --> 00:36:02,079
thanks marina glad to be here now

784
00:36:06,950 --> 00:36:04,000
perseverance is landing on mars

785
00:36:10,630 --> 00:36:06,960
at the jezero crater why is it that you

786
00:36:12,630 --> 00:36:10,640
and the team chose this particular area

787
00:36:14,870 --> 00:36:12,640
yeah so scientists believe that jezreel

788
00:36:17,270 --> 00:36:14,880

crater is one of the best places on mars

789
00:36:19,349 --> 00:36:17,280
and possibly the entire solar system

790
00:36:21,510 --> 00:36:19,359
to look for signs of ancient life

791
00:36:22,950 --> 00:36:21,520
jezreel contained an ancient lake

792
00:36:25,190 --> 00:36:22,960
and has within it one of the best

793
00:36:27,589 --> 00:36:25,200
preserved ancient delta deposits

794
00:36:29,510 --> 00:36:27,599
in on the surface of mars in delta's

795
00:36:30,630 --> 00:36:29,520
form when a river enters a relatively

796
00:36:33,030 --> 00:36:30,640
open body of water

797
00:36:34,310 --> 00:36:33,040
like an impact crater and deposits the

798
00:36:36,310 --> 00:36:34,320
sediment that it's carrying

799
00:36:37,990 --> 00:36:36,320
into the lake and we know based on

800
00:36:39,349 --> 00:36:38,000
studies of deltas and lakes here on

801
00:36:40,230 --> 00:36:39,359
earth that they're great places to

802
00:36:41,910 --> 00:36:40,240
concentrate

803
00:36:43,829 --> 00:36:41,920
and preserve organics and support

804
00:36:45,349 --> 00:36:43,839
microbial life we're also excited

805
00:36:48,630 --> 00:36:45,359
because jezreel

806
00:36:50,230 --> 00:36:48,640
exposes rocks that are between three and

807
00:36:51,829 --> 00:36:50,240
a half to more than four billion years

808
00:36:54,390 --> 00:36:51,839
old and represent a variety of different

809
00:36:56,310 --> 00:36:54,400
geological processes

810
00:36:57,750 --> 00:36:56,320
now this might be a tough choice but

811
00:37:00,150 --> 00:36:57,760
what do you think would be the most

812
00:37:03,270 --> 00:37:00,160
rewarding scientific discovery that we

813
00:37:05,270 --> 00:37:03,280

expect to get from this mission

814
00:37:07,109 --> 00:37:05,280
it's hands down i think the most

815
00:37:08,710 --> 00:37:07,119
rewarding discovery i think we can make

816
00:37:10,069 --> 00:37:08,720
with perseverance would be finding a

817
00:37:12,550 --> 00:37:10,079
truly compelling

818
00:37:14,310 --> 00:37:12,560
ancient bio signature on mars the rocks

819
00:37:16,069 --> 00:37:14,320
in and around jezreel crater record a

820
00:37:17,030 --> 00:37:16,079
period of time when life first arose in

821
00:37:18,470 --> 00:37:17,040
the solar system

822
00:37:20,550 --> 00:37:18,480
and we have the opportunity with

823
00:37:21,109 --> 00:37:20,560
perseverance to study the evolution of a

824
00:37:22,870 --> 00:37:21,119
planet

825
00:37:24,790 --> 00:37:22,880
from a once habitable world likely

826
00:37:26,790 --> 00:37:24,800
capable of supporting ancient life

827
00:37:28,790 --> 00:37:26,800
to the cold barren planet we know mars

828
00:37:30,710 --> 00:37:28,800
is today

829
00:37:33,190 --> 00:37:30,720
and why do you think katie it's so

830
00:37:37,270 --> 00:37:33,200
important to find out if there really

831
00:37:38,550 --> 00:37:37,280
is or was ancient life on mars

832
00:37:40,390 --> 00:37:38,560
well the question of whether there's

833
00:37:42,390 --> 00:37:40,400
life beyond earth is one of the most

834
00:37:44,870 --> 00:37:42,400
fundamental and essential questions we

835
00:37:46,550 --> 00:37:44,880
can ask and our ability to ask this

836
00:37:48,790 --> 00:37:46,560
question and develop the scientific

837
00:37:49,190 --> 00:37:48,800
investigations and technology to answer

838
00:37:51,190 --> 00:37:49,200

it

839
00:37:52,630 --> 00:37:51,200
is one of the things that make us as a

840
00:37:54,310 --> 00:37:52,640
species so unique

841
00:37:56,550 --> 00:37:54,320
and based on everything we know about

842
00:37:58,230 --> 00:37:56,560
mars in the past it absolutely should

843
00:37:58,790 --> 00:37:58,240
have been capable of supporting ancient

844
00:38:00,390 --> 00:37:58,800
life

845
00:38:02,150 --> 00:38:00,400
so we can find out an answer to the

846
00:38:04,390 --> 00:38:02,160
question where there were habitable

847
00:38:05,990 --> 00:38:04,400
environments was their life and studying

848
00:38:07,910 --> 00:38:06,000
the possible emergence of life on

849
00:38:09,349 --> 00:38:07,920
ancient mars can also help us better

850
00:38:12,310 --> 00:38:09,359
understand the conditions that led to

851
00:38:14,230 --> 00:38:12,320
life on our own planet earth

852
00:38:16,069 --> 00:38:14,240
that's so fascinating katie and now

853
00:38:16,950 --> 00:38:16,079
we're going to take a question from a

854
00:38:19,990 --> 00:38:16,960
student

855
00:38:23,430 --> 00:38:20,000
vara hi

856
00:38:25,430 --> 00:38:23,440
i am vara and my question is why was

857
00:38:29,109 --> 00:38:25,440
mars able to sustain

858
00:38:31,190 --> 00:38:29,119
lakes and rivers ages ago but cannot now

859
00:38:32,710 --> 00:38:31,200
isn't it cold enough to make water and

860
00:38:35,910 --> 00:38:32,720
isn't it always

861
00:38:40,310 --> 00:38:38,310
yeah that is such a great question um

862
00:38:42,230 --> 00:38:40,320
and one of the things that protects our

863
00:38:43,990 --> 00:38:42,240

atmosphere here on earth and allows

864
00:38:45,510 --> 00:38:44,000
liquid water to be stable on our own

865
00:38:46,950 --> 00:38:45,520
planet is the fact that we have a

866
00:38:47,910 --> 00:38:46,960
magnetic field protecting that

867
00:38:49,829 --> 00:38:47,920
atmosphere

868
00:38:51,030 --> 00:38:49,839
we think that mars lost its magnetic

869
00:38:53,109 --> 00:38:51,040
field way back

870
00:38:55,270 --> 00:38:53,119
billions of years ago and left the

871
00:38:56,870 --> 00:38:55,280
atmosphere exposed to things like

872
00:38:58,790 --> 00:38:56,880
solar wind and cosmic rays that

873
00:39:00,710 --> 00:38:58,800
basically blew that atmosphere away

874
00:39:02,310 --> 00:39:00,720
and once that happened liquid water

875
00:39:03,990 --> 00:39:02,320
wasn't stable on the surface of mars

876
00:39:05,349 --> 00:39:04,000
anymore it was too cold and there and

877
00:39:07,349 --> 00:39:05,359
the pressure was too low

878
00:39:09,109 --> 00:39:07,359
and so now mars is not capable of

879
00:39:10,470 --> 00:39:09,119
supporting liquid water and likely not

880
00:39:11,990 --> 00:39:10,480
capable of supporting life at its

881
00:39:13,670 --> 00:39:12,000
surface

882
00:39:15,349 --> 00:39:13,680
well thank you so much to vara for that

883
00:39:16,950 --> 00:39:15,359
great question and a big shout out to

884
00:39:19,030 --> 00:39:16,960
all the kids that are watching

885
00:39:21,190 --> 00:39:19,040
out there today and thank you so much to

886
00:39:22,950 --> 00:39:21,200
you katie for joining us that was so

887
00:39:25,109 --> 00:39:22,960
great

888
00:39:26,870 --> 00:39:25,119

thank you now sending it back over to

889
00:39:29,109 --> 00:39:26,880
you raquel

890
00:39:31,349 --> 00:39:29,119
thanks marina earlier we were able to

891
00:39:31,990 --> 00:39:31,359
catch up with the communications systems

892
00:39:34,790 --> 00:39:32,000
engineer

893
00:39:36,069 --> 00:39:34,800
chloe sakier she helps us break down the

894
00:39:39,510 --> 00:39:36,079
system used to track

895
00:39:41,430 --> 00:39:39,520
perseverance during landing

896
00:39:43,270 --> 00:39:41,440
the communications infrastructure

897
00:39:46,150 --> 00:39:43,280
supporting perseverance's landing

898
00:39:47,910 --> 00:39:46,160
is quite complex we've rallied a truly

899
00:39:49,510 --> 00:39:47,920
global network of relay and

900
00:39:51,670 --> 00:39:49,520
communications assets

901
00:39:53,670 --> 00:39:51,680
to help us capture and record those

902
00:39:55,349 --> 00:39:53,680
precious minutes of entry descent and

903
00:39:57,190 --> 00:39:55,359
landing or edl

904
00:39:59,589 --> 00:39:57,200
we receive a stream of engineering

905
00:40:00,630 --> 00:39:59,599
telemetry via these communication assets

906
00:40:03,270 --> 00:40:00,640
that helps us see

907
00:40:05,030 --> 00:40:03,280
and understand exactly what's happening

908
00:40:07,670 --> 00:40:05,040
perseverance sends direct to earth

909
00:40:09,510 --> 00:40:07,680
x-band tones each of which provides us

910
00:40:10,870 --> 00:40:09,520
with indications of critical entry

911
00:40:13,109 --> 00:40:10,880
descent and landing events

912
00:40:15,109 --> 00:40:13,119
during entry descent and landing we have

913
00:40:16,470 --> 00:40:15,119

two mars orbiters listening for the

914
00:40:19,270 --> 00:40:16,480
ultra high frequency

915
00:40:20,950 --> 00:40:19,280
or uhf signals from perseverance these

916
00:40:23,270 --> 00:40:20,960
orbiters relay these signals

917
00:40:24,630 --> 00:40:23,280
to deep space network stations on earth

918
00:40:27,190 --> 00:40:24,640
madrid in spain

919
00:40:28,390 --> 00:40:27,200
and goldstone in california the mars

920
00:40:31,430 --> 00:40:28,400
reconnaissance orbiter

921
00:40:31,990 --> 00:40:31,440
or mro has reconfigured its software to

922
00:40:34,150 --> 00:40:32,000
perform

923
00:40:35,910 --> 00:40:34,160
a type of relay called bent pipe this

924
00:40:37,750 --> 00:40:35,920
will provide us with near real-time

925
00:40:38,390 --> 00:40:37,760
telemetry during entry descent and

926
00:40:39,829 --> 00:40:38,400
landing

927
00:40:41,990 --> 00:40:39,839
we have coverage from the mars

928
00:40:42,550 --> 00:40:42,000
reconnaissance orbiter from just before

929
00:40:44,550 --> 00:40:42,560
entry

930
00:40:45,910 --> 00:40:44,560
to a few minutes after landing the

931
00:40:47,670 --> 00:40:45,920
telemetry we receive

932
00:40:49,430 --> 00:40:47,680
will be delayed by the time it takes

933
00:40:51,990 --> 00:40:49,440
light to travel from mars

934
00:40:54,230 --> 00:40:52,000
to us back on earth additionally the

935
00:40:55,829 --> 00:40:54,240
mars atmosphere and volatile evolution

936
00:40:58,230 --> 00:40:55,839
spacecraft or maven

937
00:40:59,670 --> 00:40:58,240
is recording these uhf signals and will

938
00:41:01,910 --> 00:40:59,680

be relaying that recording

939
00:41:02,710 --> 00:41:01,920
hours after landing maven will be

940
00:41:04,309 --> 00:41:02,720
covering us

941
00:41:06,230 --> 00:41:04,319
from around the time of cruise stage

942
00:41:08,950 --> 00:41:06,240
separation until a few minutes

943
00:41:10,390 --> 00:41:08,960
after landing we also receive what we

944
00:41:11,589 --> 00:41:10,400
call heartbeat tones

945
00:41:13,670 --> 00:41:11,599
which are indications that the

946
00:41:15,670 --> 00:41:13,680
spacecraft is alive and progressing

947
00:41:17,670 --> 00:41:15,680
throughout entry descent and landing

948
00:41:19,510 --> 00:41:17,680
it's important to note that while

949
00:41:21,430 --> 00:41:19,520
unexpected we could lose our

950
00:41:22,309 --> 00:41:21,440
communication links and still land

951
00:41:23,990 --> 00:41:22,319
safely

952
00:41:25,349 --> 00:41:24,000
because perseverance is doing entry

953
00:41:26,309 --> 00:41:25,359
descent and landing completely

954
00:41:27,990 --> 00:41:26,319
autonomously

955
00:41:30,150 --> 00:41:28,000
she doesn't need our help to joystick

956
00:41:33,430 --> 00:41:30,160
the landing the communication links give

957
00:41:36,950 --> 00:41:35,510
and you can see chloe hard at work

958
00:41:40,150 --> 00:41:36,960
inside mission control

959
00:41:42,230 --> 00:41:40,160
right now perseverance's landing might

960
00:41:42,630 --> 00:41:42,240
look like the system the curiosity rover

961
00:41:46,069 --> 00:41:42,640
used

962
00:41:48,790 --> 00:41:46,079
back in 2012 but landing on mars

963
00:41:49,990 --> 00:41:48,800

is difficult there's always a risk

964
00:41:51,670 --> 00:41:50,000
involved

965
00:41:53,349 --> 00:41:51,680
here's what needs to happen for

966
00:41:56,470 --> 00:41:53,359
perseverance to touch down

967
00:41:57,750 --> 00:41:56,480
safely in jezreel crater

968
00:41:59,109 --> 00:41:57,760
nothing can be taken for granted when

969
00:42:00,230 --> 00:41:59,119
you get to mars there's a lot of things

970
00:42:02,710 --> 00:42:00,240
we just don't know

971
00:42:04,630 --> 00:42:02,720
space always has a way of throwing us

972
00:42:06,150 --> 00:42:04,640
curveballs and surprising us

973
00:42:08,069 --> 00:42:06,160
i mean until we get the data that says

974
00:42:11,480 --> 00:42:08,079
we're on the ground safely i'm gonna be

975
00:42:14,870 --> 00:42:12,870
[Music]

976
00:42:16,790 --> 00:42:14,880
entry descent and landing is often

977
00:42:17,990 --> 00:42:16,800
referred to as the seven minutes of

978
00:42:20,150 --> 00:42:18,000
terror

979
00:42:21,030 --> 00:42:20,160
because it takes about seven minutes to

980
00:42:23,589 --> 00:42:21,040
get from

981
00:42:24,470 --> 00:42:23,599
the top of the atmosphere of mars to the

982
00:42:27,270 --> 00:42:24,480
ground

983
00:42:27,589 --> 00:42:27,280
safely the spacecraft has to do all of

984
00:42:30,950 --> 00:42:27,599
this

985
00:42:32,710 --> 00:42:30,960
by itself there are many things that

986
00:42:34,870 --> 00:42:32,720
have to go right to get

987
00:42:36,230 --> 00:42:34,880
perseverance onto the ground safely

988
00:42:38,069 --> 00:42:36,240

there's a lot counting on this this is

989
00:42:41,109 --> 00:42:38,079
the first leg of our sample return relay

990
00:42:43,030 --> 00:42:41,119
race there's a lot of work on the line

991
00:42:44,550 --> 00:42:43,040
starting about 10 minutes before

992
00:42:46,950 --> 00:42:44,560
atmospheric entry we

993
00:42:48,790 --> 00:42:46,960
get rid of really the spacecraft part of

994
00:42:51,510 --> 00:42:48,800
of the rover that's been supporting us

995
00:42:52,390 --> 00:42:51,520
we come screaming in to the martian

996
00:42:55,829 --> 00:42:52,400
atmosphere

997
00:42:58,390 --> 00:42:55,839
at 12 to 13 000 miles per hour

998
00:43:00,710 --> 00:42:58,400
and the heat shield is what dissipates

999
00:43:02,069 --> 00:43:00,720
all that initial energy through friction

1000
00:43:03,430 --> 00:43:02,079
the vehicle will continue actually

1001
00:43:04,870 --> 00:43:03,440
flying itself through the atmosphere

1002
00:43:06,150 --> 00:43:04,880
it's sort of like a transforming

1003
00:43:07,430 --> 00:43:06,160
vehicle that went from spacecraft and

1004
00:43:08,710 --> 00:43:07,440
now it's kind of like an aircraft

1005
00:43:11,190 --> 00:43:08,720
actively guiding itself

1006
00:43:14,069 --> 00:43:11,200
when we're going slow enough we deploy a

1007
00:43:17,589 --> 00:43:15,670
the biggest supersonic parachute we've

1008
00:43:18,950 --> 00:43:17,599
ever sent to another planet

1009
00:43:20,710 --> 00:43:18,960
it's critical for slowing down the

1010
00:43:23,030 --> 00:43:20,720
vehicle

1011
00:43:25,109 --> 00:43:23,040
perseverances entry descent and landing

1012
00:43:28,069 --> 00:43:25,119
borrows heavily from that of

1013
00:43:28,470 --> 00:43:28,079

curiosity but fundamentally perseverance

1014
00:43:31,030 --> 00:43:28,480
is a

1015
00:43:32,150 --> 00:43:31,040
different rover she's bigger she has

1016
00:43:33,430 --> 00:43:32,160
different instruments

1017
00:43:35,349 --> 00:43:33,440
we've added a lot of smarts on the

1018
00:43:36,630 --> 00:43:35,359
inside to make it more capable

1019
00:43:38,309 --> 00:43:36,640
so that it can deal with the landing

1020
00:43:40,470 --> 00:43:38,319
site that we've given the science team

1021
00:43:42,150 --> 00:43:40,480
identified jezreel crater as

1022
00:43:44,309 --> 00:43:42,160
basically an ancient lake bed and one of

1023
00:43:46,069 --> 00:43:44,319
the most promising places to look for

1024
00:43:47,990 --> 00:43:46,079
evidence of ancient microbial life and

1025
00:43:48,950 --> 00:43:48,000
to collect samples for future return to

1026
00:43:50,390 --> 00:43:48,960
earth

1027
00:43:52,390 --> 00:43:50,400
the problem is it's a much more

1028
00:43:54,230 --> 00:43:52,400
hazardous place to land

1029
00:43:55,990 --> 00:43:54,240
you look at jezreel all you see is

1030
00:43:57,430 --> 00:43:56,000
danger how do we go to a site

1031
00:43:59,670 --> 00:43:57,440
that we never thought was safe enough to

1032
00:44:00,710 --> 00:43:59,680
go to before so the heat shield which

1033
00:44:02,309 --> 00:44:00,720
has protected us all the way through

1034
00:44:03,990 --> 00:44:02,319
entry is no longer necessary we need to

1035
00:44:04,710 --> 00:44:04,000
get that off so that we can actually see

1036
00:44:08,150 --> 00:44:04,720
the ground

1037
00:44:09,829 --> 00:44:08,160
different ways perseverance will be

1038
00:44:11,430 --> 00:44:09,839

the first mission to use terrain

1039
00:44:13,190 --> 00:44:11,440
relative navigation

1040
00:44:15,190 --> 00:44:13,200
so while it's descending on the

1041
00:44:17,990 --> 00:44:15,200
parachute it will actually be taking

1042
00:44:18,710 --> 00:44:18,000
images of the surface of mars and

1043
00:44:21,190 --> 00:44:18,720
determining

1044
00:44:23,430 --> 00:44:21,200
where to go based on what it sees this

1045
00:44:24,309 --> 00:44:23,440
is finally like landing with your eyes

1046
00:44:26,630 --> 00:44:24,319
open

1047
00:44:27,589 --> 00:44:26,640
having this new technology really allows

1048
00:44:30,470 --> 00:44:27,599
perseverance

1049
00:44:30,870 --> 00:44:30,480
to land in much more challenging terrain

1050
00:44:33,430 --> 00:44:30,880
than

1051
00:44:34,790 --> 00:44:33,440
curiosity or any previous mars mission

1052
00:44:37,349 --> 00:44:34,800
could amongst

1053
00:44:38,470 --> 00:44:37,359
the rocks and the craters and the cliffs

1054
00:44:41,510 --> 00:44:38,480
these things are

1055
00:44:42,470 --> 00:44:41,520
hazardous to the rover but

1056
00:44:44,550 --> 00:44:42,480
these are the things that are

1057
00:44:46,150 --> 00:44:44,560
interesting to the scientists

1058
00:44:48,829 --> 00:44:46,160
once perseverance has figured out where

1059
00:44:53,190 --> 00:44:48,839
she is jettison the back shell and

1060
00:44:56,950 --> 00:44:55,109
those rockets help us steer to a safe

1061
00:44:58,950 --> 00:44:56,960
landing spot that's nearby

1062
00:45:00,470 --> 00:44:58,960
that descent stage takes us all the way

1063
00:45:02,230 --> 00:45:00,480

down to about 20 meters

1064
00:45:04,300 --> 00:45:02,240
off the ground that's when we start the

1065
00:45:07,270 --> 00:45:04,310
sky crane

1066
00:45:09,190 --> 00:45:07,280
[Music]

1067
00:45:10,710 --> 00:45:09,200
once the rover has hit the ground the

1068
00:45:13,510 --> 00:45:10,720
descent stage will cut loose from the

1069
00:45:15,750 --> 00:45:13,520
rover and fly away to a safe distance

1070
00:45:18,069 --> 00:45:15,760
surviving that seven minutes is really

1071
00:45:19,750 --> 00:45:18,079
just the beginning for perseverance its

1072
00:45:21,510 --> 00:45:19,760
job right being the first leg of sample

1073
00:45:23,910 --> 00:45:21,520
return to go look for those signs of

1074
00:45:25,910 --> 00:45:23,920
past life on mars all that can't start

1075
00:45:27,829 --> 00:45:25,920
until we get perseverant safely to the

1076
00:45:34,210 --> 00:45:27,839
ground and then that's when the real

1077
00:45:34,220 --> 00:45:55,030
[Music]

1078
00:46:00,150 --> 00:45:57,670
with us now is al chen he is

1079
00:46:01,190 --> 00:46:00,160
perseverance's entry descent and landing

1080
00:46:03,349 --> 00:46:01,200
lead

1081
00:46:05,510 --> 00:46:03,359
al you were part of the curiosity rover

1082
00:46:07,109 --> 00:46:05,520
landing does it get any easier the

1083
00:46:08,870 --> 00:46:07,119
second time around

1084
00:46:10,309 --> 00:46:08,880
it absolutely does not especially when

1085
00:46:10,870 --> 00:46:10,319
considering we're trying to land the

1086
00:46:13,030 --> 00:46:10,880
biggest

1087
00:46:14,950 --> 00:46:13,040
heaviest and most complex rover we've

1088
00:46:16,630 --> 00:46:14,960

ever built at the most dangerous landing

1089
00:46:18,390 --> 00:46:16,640
site we've ever attempted

1090
00:46:19,990 --> 00:46:18,400
jezreel may look great and you know

1091
00:46:22,230 --> 00:46:20,000
promising from a science perspective but

1092
00:46:24,150 --> 00:46:22,240
it's absolutely treacherous for landing

1093
00:46:25,750 --> 00:46:24,160
there's a cliff cliff wall that's about

1094
00:46:27,109 --> 00:46:25,760
200 feet tall that runs right through

1095
00:46:28,630 --> 00:46:27,119
the middle of landing site

1096
00:46:29,990 --> 00:46:28,640
there are craters full of sand that even

1097
00:46:31,109 --> 00:46:30,000
if we landed them we would not be able

1098
00:46:32,950 --> 00:46:31,119
to drive out of

1099
00:46:34,230 --> 00:46:32,960
and there are rocks to the east and

1100
00:46:35,109 --> 00:46:34,240
actually all over the place and rock

1101
00:46:36,390 --> 00:46:35,119
fields

1102
00:46:38,390 --> 00:46:36,400
that would be a bad day for us if we

1103
00:46:41,510 --> 00:46:38,400
were to land on them

1104
00:46:43,990 --> 00:46:41,520
now al what new technology makes this

1105
00:46:45,349 --> 00:46:44,000
type of land dangerous landing possible

1106
00:46:46,790 --> 00:46:45,359
perseverance is carrying two new

1107
00:46:47,990 --> 00:46:46,800
technologies that are really kind of

1108
00:46:49,829 --> 00:46:48,000
under the hood smarts

1109
00:46:51,750 --> 00:46:49,839
that are allowing us to land at this

1110
00:46:53,589 --> 00:46:51,760
kind of treacherous landing site

1111
00:46:54,950 --> 00:46:53,599
the first is range trigger that's the

1112
00:46:56,550 --> 00:46:54,960
ability we've given perseverance the

1113
00:46:58,710 --> 00:46:56,560

ability to decide for herself

1114
00:47:00,630 --> 00:46:58,720
based on where she is when to deploy the

1115
00:47:02,550 --> 00:47:00,640
parachute previously we used to deploy

1116
00:47:05,030 --> 00:47:02,560
parachutes that supersonic parachute

1117
00:47:06,390 --> 00:47:05,040
based just on navigated velocity but now

1118
00:47:07,430 --> 00:47:06,400
perseverance has the smarts to figure

1119
00:47:09,030 --> 00:47:07,440
out where she is

1120
00:47:10,470 --> 00:47:09,040
and deploy that parachute at just the

1121
00:47:12,470 --> 00:47:10,480
right place to make sure that

1122
00:47:14,390 --> 00:47:12,480
we shrink where we could come down that

1123
00:47:16,150 --> 00:47:14,400
actually reduces the area that

1124
00:47:18,309 --> 00:47:16,160
error ellipse the where we can come down

1125
00:47:20,470 --> 00:47:18,319
on the ground from something that was on

1126
00:47:21,990 --> 00:47:20,480
the order of 15 miles long by 12 miles

1127
00:47:24,870 --> 00:47:22,000
wide for curiosity

1128
00:47:26,309 --> 00:47:24,880
to about 5 miles long by four miles wide

1129
00:47:27,910 --> 00:47:26,319
for perseverance so that's quite a bit

1130
00:47:29,829 --> 00:47:27,920
of reduction

1131
00:47:31,349 --> 00:47:29,839
second uh the next piece of technology

1132
00:47:32,710 --> 00:47:31,359
that's helping us land there is terrain

1133
00:47:34,309 --> 00:47:32,720
relative navigation

1134
00:47:36,150 --> 00:47:34,319
um in the past after we've popped off

1135
00:47:37,589 --> 00:47:36,160
the heat shield we've taken pictures of

1136
00:47:39,670 --> 00:47:37,599
the ground as it's been coming up but we

1137
00:47:41,430 --> 00:47:39,680
haven't really done anything with them

1138
00:47:43,349 --> 00:47:41,440

this time perseverance is carrying a

1139
00:47:44,630 --> 00:47:43,359
camera to take pictures but also a kind

1140
00:47:45,829 --> 00:47:44,640
of second brain

1141
00:47:47,589 --> 00:47:45,839
to help it figure out what those

1142
00:47:48,710 --> 00:47:47,599
pictures are telling it and match it up

1143
00:47:50,790 --> 00:47:48,720
with an onboard map

1144
00:47:52,549 --> 00:47:50,800
from a satellite that allows it to

1145
00:47:54,230 --> 00:47:52,559
figure out exactly where she is

1146
00:47:56,069 --> 00:47:54,240
uh suddenly then she can she can then

1147
00:47:57,750 --> 00:47:56,079
fly to safe spots that are nearby when

1148
00:47:59,670 --> 00:47:57,760
she really knows where she is

1149
00:48:01,270 --> 00:47:59,680
it allows the site to not have to be as

1150
00:48:02,390 --> 00:48:01,280
flat and boring as a pancake as if some

1151
00:48:04,390 --> 00:48:02,400
of our past sites had been

1152
00:48:06,470 --> 00:48:04,400
the entire area we could come down now

1153
00:48:08,470 --> 00:48:06,480
we just need little pieces of that site

1154
00:48:10,870 --> 00:48:08,480
to be small enough and safe enough uh

1155
00:48:12,150 --> 00:48:10,880
for us to land in safely and fly there

1156
00:48:14,790 --> 00:48:12,160
after we've just after we've gotten rid

1157
00:48:17,069 --> 00:48:14,800
of the parachute and we also have a

1158
00:48:20,309 --> 00:48:17,079
social media question coming in

1159
00:48:22,309 --> 00:48:20,319
sansari14 on instagram is asking

1160
00:48:25,190 --> 00:48:22,319
how does the sky crane decide where to

1161
00:48:26,710 --> 00:48:25,200
move itself after the payload lands

1162
00:48:28,870 --> 00:48:26,720
after the payload lands after the rover

1163
00:48:30,069 --> 00:48:28,880

touches down the the sky crane the

1164
00:48:31,670 --> 00:48:30,079
descent stage which is that rocket

1165
00:48:33,270 --> 00:48:31,680
powered jet pack above it

1166
00:48:35,109 --> 00:48:33,280
the first job of course is to make sure

1167
00:48:38,069 --> 00:48:35,119
you don't hurt the rover so it'll turn

1168
00:48:39,829 --> 00:48:38,079
forward or backward so that the engine

1169
00:48:41,990 --> 00:48:39,839
plumes don't pass over the rover

1170
00:48:43,349 --> 00:48:42,000
so it'll come up and start to turn and

1171
00:48:43,990 --> 00:48:43,359
it'll go in whichever direction is

1172
00:48:45,829 --> 00:48:44,000
closest

1173
00:48:47,270 --> 00:48:45,839
to north so it can either go forward if

1174
00:48:48,870 --> 00:48:47,280
that's the way north is or go

1175
00:48:50,630 --> 00:48:48,880
toward the rear of the rover if that's

1176
00:48:53,270 --> 00:48:50,640
where north is and it'll fly about a

1177
00:48:55,589 --> 00:48:53,280
third of a mile or so away

1178
00:48:56,710 --> 00:48:55,599
thanks for talking to us today al thank

1179
00:48:59,030 --> 00:48:56,720
you very much

1180
00:49:03,589 --> 00:48:59,040
now let's head back to mission control

1181
00:49:06,390 --> 00:49:03,599
for an update from swati

1182
00:49:07,109 --> 00:49:06,400
hi raquel so remember that command that

1183
00:49:09,670 --> 00:49:07,119
we sent

1184
00:49:10,470 --> 00:49:09,680
at around 11 35 to turn the transmitter

1185
00:49:13,750 --> 00:49:10,480
off

1186
00:49:16,710 --> 00:49:13,760
we are just about to get confirmation

1187
00:49:18,230 --> 00:49:16,720
that perseverance has received the

1188
00:49:22,870 --> 00:49:18,240

command

1189
00:49:23,990 --> 00:49:22,880
perseverance and then the reply took 11

1190
00:49:26,630 --> 00:49:24,000
minutes to get

1191
00:49:27,190 --> 00:49:26,640
back from perseverance to the ground so

1192
00:49:31,030 --> 00:49:27,200
we

1193
00:49:32,470 --> 00:49:31,040
should hear about any second now that

1194
00:49:34,870 --> 00:49:32,480
we have officially turned off the

1195
00:49:38,230 --> 00:49:34,880
transmitter and after that we will be

1196
00:49:40,390 --> 00:49:38,240
about four minutes from the start

1197
00:49:41,910 --> 00:49:40,400
of entry descent and landing mode at

1198
00:49:44,470 --> 00:49:41,920
this point we will transition

1199
00:49:45,910 --> 00:49:44,480
from the cruise approach mode to entry

1200
00:49:48,950 --> 00:49:45,920
descent and landing

1201
00:49:50,150 --> 00:49:48,960
and that means our travel from earth to

1202
00:49:52,309 --> 00:49:50,160
mars is done

1203
00:49:53,270 --> 00:49:52,319
and now we just need to get to the

1204
00:50:01,190 --> 00:49:53,280
surface

1205
00:50:04,950 --> 00:50:03,109
oh well this is chad three ready to show

1206
00:50:25,109 --> 00:50:04,960
miss estimated assistance for

1207
00:50:28,549 --> 00:50:26,710
our tracking stations have all confirmed

1208
00:50:33,349 --> 00:50:28,559
the results of the transmitter drive off

1209
00:50:36,630 --> 00:50:33,359
and in lock one way copy ace

1210
00:50:38,150 --> 00:50:36,640
gts light flight gts

1211
00:50:40,790 --> 00:50:38,160
at this time i'd like to disable the

1212
00:50:42,790 --> 00:50:40,800
alarms before edl main

1213
00:50:45,430 --> 00:50:42,800

so please disable all the alarm files

1214
00:50:47,910 --> 00:50:45,440
and start a new downlink session

1215
00:50:52,950 --> 00:50:47,920
we'll talk about that copy that

1216
00:51:01,030 --> 00:50:54,710
we are now officially one way and the

1217
00:51:05,910 --> 00:51:04,390
rover mission has helped shape the other

1218
00:51:08,150 --> 00:51:05,920
starting with the landing of the

1219
00:51:10,470 --> 00:51:08,160
pathfinder more than 20

1220
00:51:12,309 --> 00:51:10,480
years ago leading up to where we are

1221
00:51:14,309 --> 00:51:12,319
today with perseverance

1222
00:51:15,589 --> 00:51:14,319
perseverance deputy project manager

1223
00:51:18,549 --> 00:51:15,599
jennifer trosper

1224
00:51:19,030 --> 00:51:18,559
has worked on every mars rover mission

1225
00:51:22,630 --> 00:51:19,040
and

1226
00:51:24,549 --> 00:51:22,640
she joins us now jennifer

1227
00:51:27,270 --> 00:51:24,559
how does perseverance fit into the

1228
00:51:29,910 --> 00:51:27,280
history of exploring mars

1229
00:51:31,589 --> 00:51:29,920
thanks raquel it's great to be here well

1230
00:51:33,829 --> 00:51:31,599
perseverance is nasa's

1231
00:51:35,270 --> 00:51:33,839
fifth rover on mars and i've had the

1232
00:51:37,589 --> 00:51:35,280
privilege of working on

1233
00:51:39,950 --> 00:51:37,599
every one of them and the very first

1234
00:51:43,349 --> 00:51:39,960
rover was the sojourner rover we sent in

1235
00:51:46,309 --> 00:51:43,359
1997 and it was the size of a microwave

1236
00:51:48,630 --> 00:51:46,319
oven and even at that small size

1237
00:51:50,710 --> 00:51:48,640
sojourner was able to transform the way

1238
00:51:54,150 --> 00:51:50,720

that we explore mars from

1239
00:51:56,309 --> 00:51:54,160
stationary landers to small roving

1240
00:51:57,829 --> 00:51:56,319
robots that go from place to place just

1241
00:52:00,309 --> 00:51:57,839
like a geologist would

1242
00:52:01,589 --> 00:52:00,319
on earth so once we had that roving

1243
00:52:03,990 --> 00:52:01,599
capability

1244
00:52:05,190 --> 00:52:04,000
then we sent our twin rovers spirit and

1245
00:52:08,630 --> 00:52:05,200
opportunity

1246
00:52:11,829 --> 00:52:08,640
finding

1247
00:52:12,470 --> 00:52:11,839
evidence of ancient water on mars now

1248
00:52:14,470 --> 00:52:12,480
they did

1249
00:52:16,870 --> 00:52:14,480
they're great explorers and both of them

1250
00:52:19,349 --> 00:52:16,880
found ample evidence that water had once

1251
00:52:21,270 --> 00:52:19,359
existed on the surface of mars

1252
00:52:22,630 --> 00:52:21,280
but we had a question another question

1253
00:52:25,109 --> 00:52:22,640
then was

1254
00:52:26,549 --> 00:52:25,119
mars ever habitable if water had been

1255
00:52:28,950 --> 00:52:26,559
there and that's when we sent

1256
00:52:29,990 --> 00:52:28,960
curiosity now curiosity was a major

1257
00:52:32,230 --> 00:52:30,000
upgrade

1258
00:52:33,430 --> 00:52:32,240
to our rover fleet she's the size of a

1259
00:52:35,910 --> 00:52:33,440
small car

1260
00:52:37,589 --> 00:52:35,920
she landed with the sky crane system

1261
00:52:39,349 --> 00:52:37,599
instead of air bags

1262
00:52:40,870 --> 00:52:39,359
and she also carries along her own

1263
00:52:43,430 --> 00:52:40,880

sample analytics lab

1264
00:52:45,750 --> 00:52:43,440
and she's still operating today and

1265
00:52:47,910 --> 00:52:45,760
during her exploration she has found

1266
00:52:50,950 --> 00:52:47,920
evidence of a habitable environment

1267
00:52:52,710 --> 00:52:50,960
in an ancient lake bed on mars so now

1268
00:52:55,589 --> 00:52:52,720
we're sending perseverance

1269
00:52:56,390 --> 00:52:55,599
perseverance is tasked with answering

1270
00:52:58,790 --> 00:52:56,400
the question

1271
00:52:59,990 --> 00:52:58,800
and looking for evidence of ancient

1272
00:53:02,710 --> 00:53:00,000
microbial life

1273
00:53:04,470 --> 00:53:02,720
on mars and in order to do this she has

1274
00:53:06,630 --> 00:53:04,480
to be the smartest and most capable

1275
00:53:08,470 --> 00:53:06,640
rover we've ever sent

1276
00:53:10,150 --> 00:53:08,480
speaking of perseverance can you tell us

1277
00:53:12,630 --> 00:53:10,160
more about how perseverance

1278
00:53:13,510 --> 00:53:12,640
is smarter than its predecessors yes

1279
00:53:16,150 --> 00:53:13,520
we've made

1280
00:53:17,670 --> 00:53:16,160
a lot of upgrades to help her along with

1281
00:53:19,670 --> 00:53:17,680
the surface mission

1282
00:53:21,270 --> 00:53:19,680
one of them is for her autonomous

1283
00:53:23,270 --> 00:53:21,280
traverse capability

1284
00:53:25,510 --> 00:53:23,280
when i say autonomous traverse i mean we

1285
00:53:27,750 --> 00:53:25,520
tell her where we want her to end up

1286
00:53:29,190 --> 00:53:27,760
and she has to figure out the safe and

1287
00:53:31,510 --> 00:53:29,200
best way to get there

1288
00:53:33,190 --> 00:53:31,520

in order to do that she uses her cameras

1289
00:53:34,950 --> 00:53:33,200
algorithms a computer

1290
00:53:36,790 --> 00:53:34,960
so we've given her another computer

1291
00:53:38,309 --> 00:53:36,800
we've upgraded the cameras and we've

1292
00:53:40,710 --> 00:53:38,319
upgraded the algorithms

1293
00:53:42,069 --> 00:53:40,720
now she drives three times as fast as

1294
00:53:45,109 --> 00:53:42,079
curiosity could drive

1295
00:53:45,430 --> 00:53:45,119
in this autonomous traverse mode in fact

1296
00:53:48,710 --> 00:53:45,440
her

1297
00:53:51,109 --> 00:53:48,720
average daily distance for driving about

1298
00:53:53,430 --> 00:53:51,119
200 meters is close to the maximum

1299
00:53:55,589 --> 00:53:53,440
distance any rover has ever driven in a

1300
00:53:57,190 --> 00:53:55,599
day on mars so she's fast

1301
00:53:59,109 --> 00:53:57,200
another thing that we've done which is

1302
00:54:01,430 --> 00:53:59,119
the most significant upgrade

1303
00:54:03,349 --> 00:54:01,440
that we've made is the sample caching

1304
00:54:05,430 --> 00:54:03,359
system itself

1305
00:54:07,510 --> 00:54:05,440
curiosity has a robotic arm like

1306
00:54:10,150 --> 00:54:07,520
perseverance has a robotic arm but on

1307
00:54:12,710 --> 00:54:10,160
the end of perseverance's robotic arm

1308
00:54:14,150 --> 00:54:12,720
is a coring drill that will go and take

1309
00:54:16,309 --> 00:54:14,160
rock cores

1310
00:54:18,790 --> 00:54:16,319
transfer them into sample tubes and into

1311
00:54:21,750 --> 00:54:18,800
the rover where another robotic arm

1312
00:54:22,470 --> 00:54:21,760
will take those tubes will seal them and

1313
00:54:24,470 --> 00:54:22,480

store them

1314
00:54:27,589 --> 00:54:24,480
and eventually drop them on the surface

1315
00:54:29,750 --> 00:54:27,599
of mars for future return to earth

1316
00:54:31,109 --> 00:54:29,760
great and we also have a social media

1317
00:54:34,230 --> 00:54:31,119
question about perseverance

1318
00:54:36,309 --> 00:54:34,240
erica a s on instagram wants to know

1319
00:54:37,349 --> 00:54:36,319
what the wheels of the rover are made

1320
00:54:38,950 --> 00:54:37,359
out of

1321
00:54:40,390 --> 00:54:38,960
great question well you may think we

1322
00:54:42,950 --> 00:54:40,400
make them out of some

1323
00:54:44,710 --> 00:54:42,960
material you've never heard of it turns

1324
00:54:46,390 --> 00:54:44,720
out they're made of aluminum

1325
00:54:47,990 --> 00:54:46,400
now perseverance's wheels are a little

1326
00:54:48,549 --> 00:54:48,000
thicker than curiosities but they're

1327
00:54:51,990 --> 00:54:48,559
actually

1328
00:54:54,150 --> 00:54:52,000
both made out of aluminum and one more

1329
00:54:56,069 --> 00:54:54,160
question for you can you tell us more

1330
00:54:59,109 --> 00:54:56,079
about the importance of where you are

1331
00:55:00,950 --> 00:54:59,119
right now in the building yes i am

1332
00:55:02,470 --> 00:55:00,960
above on the second floor above the

1333
00:55:03,430 --> 00:55:02,480
cruise mission support area that you've

1334
00:55:05,430 --> 00:55:03,440
been watching

1335
00:55:06,870 --> 00:55:05,440
and this is the surface mission support

1336
00:55:10,069 --> 00:55:06,880
area so as soon

1337
00:55:10,870 --> 00:55:10,079
as perseverance lands all commands i'll

1338
00:55:12,309 --> 00:55:10,880

take out this

1339
00:55:14,950 --> 00:55:12,319
this room will take over become

1340
00:55:16,549 --> 00:55:14,960
headquarters for operating perseverance

1341
00:55:17,990 --> 00:55:16,559
on mars

1342
00:55:20,230 --> 00:55:18,000
thanks for taking the time to talk to us

1343
00:55:22,950 --> 00:55:20,240
today jennifer thank you

1344
00:55:23,990 --> 00:55:22,960
now we now know perseverance's place in

1345
00:55:26,950 --> 00:55:24,000
history

1346
00:55:27,270 --> 00:55:26,960
let's take an up-close look at the rover

1347
00:55:30,309 --> 00:55:27,280
with

1348
00:55:34,710 --> 00:55:30,319
mars 2020 system testbed engineer

1349
00:55:37,109 --> 00:55:34,720
elio morillo thank you

1350
00:55:38,069 --> 00:55:37,119
i'm standing in front of the mars 2020

1351
00:55:40,710 --> 00:55:38,079
perseverance

1352
00:55:41,349 --> 00:55:40,720
scaled model as you can tell this

1353
00:55:44,309 --> 00:55:41,359
vehicle

1354
00:55:45,349 --> 00:55:44,319
is about the size of a mini cooper these

1355
00:55:47,190 --> 00:55:45,359
wheels are obviously

1356
00:55:48,789 --> 00:55:47,200
black here and they look like rubber but

1357
00:55:50,470 --> 00:55:48,799
they're actually fully made of metal

1358
00:55:52,309 --> 00:55:50,480
these wheels are designed to allow us to

1359
00:55:53,270 --> 00:55:52,319
climb over obstacles and of course climb

1360
00:55:55,829 --> 00:55:53,280
over hills

1361
00:55:58,230 --> 00:55:55,839
and minimize the amount of slipping once

1362
00:55:59,750 --> 00:55:58,240
we're traversing on the surface of mars

1363
00:56:01,990 --> 00:55:59,760

here in the front of the rover we have

1364
00:56:03,670 --> 00:56:02,000
the sample caching system and of course

1365
00:56:06,150 --> 00:56:03,680
at the very front end of this is the

1366
00:56:08,710 --> 00:56:06,160
robotic arm which this entire system is

1367
00:56:09,510 --> 00:56:08,720
arguably the most complex robotic system

1368
00:56:12,150 --> 00:56:09,520
we've ever sent

1369
00:56:12,549 --> 00:56:12,160
outside of earth here at the tip of the

1370
00:56:14,870 --> 00:56:12,559
arm

1371
00:56:15,990 --> 00:56:14,880
we have a turret which contains a suite

1372
00:56:18,630 --> 00:56:16,000
of instruments along

1373
00:56:21,030 --> 00:56:18,640
with some drills and coring capabilities

1374
00:56:23,190 --> 00:56:21,040
that will allow us to do contact science

1375
00:56:24,630 --> 00:56:23,200
once we get to the surface of mars not

1376
00:56:26,789 --> 00:56:24,640
only that

1377
00:56:28,950 --> 00:56:26,799
this robotic system is equipped to

1378
00:56:31,030 --> 00:56:28,960
collect samples about the size of

1379
00:56:31,990 --> 00:56:31,040
a piece of chalk that then eventually

1380
00:56:34,150 --> 00:56:32,000
will be stored

1381
00:56:35,270 --> 00:56:34,160
inside of the vehicle and dropped off in

1382
00:56:37,190 --> 00:56:35,280
a later location

1383
00:56:39,190 --> 00:56:37,200
so that an eventual mission can go and

1384
00:56:41,670 --> 00:56:39,200
return these samples to earth something

1385
00:56:43,670 --> 00:56:41,680
we've never done in the past here in the

1386
00:56:46,630 --> 00:56:43,680
front we have the remote sensing

1387
00:56:48,549 --> 00:56:46,640
mast something of note is that this

1388
00:56:50,470 --> 00:56:48,559

mechanism is going to be stowed upon the

1389
00:56:52,069 --> 00:56:50,480
touchdown on the surface of mars and one

1390
00:56:53,910 --> 00:56:52,079
of the first critical activities we do

1391
00:56:56,150 --> 00:56:53,920
is deploy this mechanism

1392
00:56:57,109 --> 00:56:56,160
this mechanism includes several cameras

1393
00:56:57,990 --> 00:56:57,119
that are going to give us some of the

1394
00:57:00,150 --> 00:56:58,000
most breathtaking

1395
00:57:01,829 --> 00:57:00,160
images we've ever taken on mars along

1396
00:57:02,789 --> 00:57:01,839
with that we have some lasers as well as

1397
00:57:04,150 --> 00:57:02,799
a spectrometer

1398
00:57:06,549 --> 00:57:04,160
they're going to allow us to do some

1399
00:57:08,069 --> 00:57:06,559
remote science here you see

1400
00:57:09,510 --> 00:57:08,079
some of these extrusions that are part

1401
00:57:10,230 --> 00:57:09,520
of the larger weather suite of

1402
00:57:12,150 --> 00:57:10,240
instruments

1403
00:57:14,710 --> 00:57:12,160
that will allow us to characterize the

1404
00:57:16,710 --> 00:57:14,720
local climate around perseverance

1405
00:57:17,910 --> 00:57:16,720
so that's a quick tour of the rover but

1406
00:57:37,030 --> 00:57:17,920
i gotta get back to work

1407
00:57:42,309 --> 00:57:39,349
perseverance is collecting samples of

1408
00:57:43,910 --> 00:57:42,319
martian rock for future return to earth

1409
00:57:46,630 --> 00:57:43,920
we've heard that scientists have been

1410
00:57:49,829 --> 00:57:46,640
wanting to bring martian samples back

1411
00:57:50,789 --> 00:57:49,839
for many generations and here to talk a

1412
00:57:52,950 --> 00:57:50,799
little bit about that

1413
00:57:54,549 --> 00:57:52,960

is nasa's planetary science division

1414
00:57:56,870 --> 00:57:54,559
director lori glaze

1415
00:57:57,750 --> 00:57:56,880
who joins us now to talk about the role

1416
00:58:00,789 --> 00:57:57,760
perseverance

1417
00:58:01,510 --> 00:58:00,799
will play in nasa's future goals welcome

1418
00:58:04,470 --> 00:58:01,520
lori

1419
00:58:05,750 --> 00:58:04,480
hi now as you just heard we've heard

1420
00:58:07,910 --> 00:58:05,760
that scientists have been wanting to

1421
00:58:09,349 --> 00:58:07,920
bring back these martian samples for a

1422
00:58:11,589 --> 00:58:09,359
very long time

1423
00:58:13,670 --> 00:58:11,599
why do we need to bring them back that's

1424
00:58:15,990 --> 00:58:13,680
really a great great question

1425
00:58:18,069 --> 00:58:16,000
you know we actually have examples of

1426
00:58:19,670 --> 00:58:18,079
mars already here on earth that came

1427
00:58:21,589 --> 00:58:19,680
here as meteorites

1428
00:58:23,589 --> 00:58:21,599
but we don't know exactly where they

1429
00:58:25,430 --> 00:58:23,599
came from on mars and then they also

1430
00:58:26,470 --> 00:58:25,440
have had to make the trip from mars to

1431
00:58:28,309 --> 00:58:26,480
earth and so they

1432
00:58:30,230 --> 00:58:28,319
got altered during that time and then

1433
00:58:32,710 --> 00:58:30,240
during their entry and descent into the

1434
00:58:34,710 --> 00:58:32,720
earth's atmosphere that also changes

1435
00:58:38,549 --> 00:58:34,720
what those those rocks are like

1436
00:58:40,470 --> 00:58:38,559
so being able to go to mars and actually

1437
00:58:41,750 --> 00:58:40,480
collect a sample where we know exactly

1438
00:58:44,230 --> 00:58:41,760

where it came from

1439
00:58:45,030 --> 00:58:44,240
and we know we can preserve it and keep

1440
00:58:46,950 --> 00:58:45,040
it pristine

1441
00:58:49,190 --> 00:58:46,960
and carry it all the way back here this

1442
00:58:51,430 --> 00:58:49,200
will be incredibly important to help us

1443
00:58:53,990 --> 00:58:51,440
answer questions about

1444
00:58:54,950 --> 00:58:54,000
the geologic history of mars

1445
00:58:57,270 --> 00:58:54,960
understanding

1446
00:58:59,109 --> 00:58:57,280
how it formed and evolved and also

1447
00:58:59,990 --> 00:58:59,119
really important questions about whether

1448
00:59:02,230 --> 00:59:00,000
or not

1449
00:59:03,750 --> 00:59:02,240
life actually existed on mars three and

1450
00:59:03,990 --> 00:59:03,760
a half billion years ago and whether

1451
00:59:06,309 --> 00:59:04,000
that

1452
00:59:08,630 --> 00:59:06,319
life if it existed has been preserved in

1453
00:59:10,870 --> 00:59:08,640
the surface of mars

1454
00:59:12,309 --> 00:59:10,880
now lori these sample tubes that

1455
00:59:14,549 --> 00:59:12,319
perseverance is going to be

1456
00:59:16,069 --> 00:59:14,559
collecting they're the cleanest things

1457
00:59:16,789 --> 00:59:16,079
ever created on earth tell me a little

1458
00:59:19,910 --> 00:59:16,799
bit about that

1459
00:59:22,150 --> 00:59:19,920
oh my goodness we worked so hard

1460
00:59:23,349 --> 00:59:22,160
the team here at jpl is absolutely

1461
00:59:25,829 --> 00:59:23,359
incredible to

1462
00:59:27,510 --> 00:59:25,839
assure that those sample tubes are

1463
00:59:30,230 --> 00:59:27,520

incredibly clean

1464
00:59:30,789 --> 00:59:30,240
one of the main goals of this mission is

1465
00:59:34,789 --> 00:59:30,799
to

1466
00:59:37,349 --> 00:59:34,799
that's preserved

1467
00:59:38,390 --> 00:59:37,359
um ancient life preserved in those rocks

1468
00:59:39,990 --> 00:59:38,400
in those samples

1469
00:59:42,309 --> 00:59:40,000
and we definitely don't want to be

1470
00:59:43,990 --> 00:59:42,319
carrying you know our own dna

1471
00:59:45,589 --> 00:59:44,000
off to mars and then bring it back here

1472
00:59:45,990 --> 00:59:45,599
to confuse our our scientists when

1473
00:59:48,549 --> 00:59:46,000
they're trying

1474
00:59:50,069 --> 00:59:48,559
to study those samples so it it is an

1475
00:59:52,390 --> 00:59:50,079
incredibly clean

1476
00:59:53,910 --> 00:59:52,400
set of equipment that's been sent there

1477
00:59:56,390 --> 00:59:53,920
as you said the cleanest thing we've

1478
00:59:59,190 --> 00:59:56,400
ever sent into space

1479
00:59:59,990 --> 00:59:59,200
now this is a very complicated campaign

1480
01:00:02,069 --> 01:00:00,000
can you break down

1481
01:00:03,750 --> 01:00:02,079
for us how it's going to work and if

1482
01:00:04,950 --> 01:00:03,760
there's any international partners

1483
01:00:06,870 --> 01:00:04,960
working with us

1484
01:00:08,150 --> 01:00:06,880
you are correct the the marsh sample

1485
01:00:10,549 --> 01:00:08,160
return campaign

1486
01:00:12,309 --> 01:00:10,559
is incredibly complex in fact it's

1487
01:00:14,150 --> 01:00:12,319
probably the most challenging thing

1488
01:00:15,750 --> 01:00:14,160

we've ever tried to do

1489
01:00:17,670 --> 01:00:15,760
but we're definitely not going to try

1490
01:00:20,470 --> 01:00:17,680
and do it alone we have

1491
01:00:21,430 --> 01:00:20,480
great partners with the european space

1492
01:00:23,430 --> 01:00:21,440
agency

1493
01:00:25,430 --> 01:00:23,440
and the way this campaign is going to

1494
01:00:27,910 --> 01:00:25,440
work well perseverance is the first step

1495
01:00:29,510 --> 01:00:27,920
chapter one is going to mars and

1496
01:00:32,150 --> 01:00:29,520
collecting the samples

1497
01:00:32,630 --> 01:00:32,160
chapter two is going to be a sample

1498
01:00:34,630 --> 01:00:32,640
return

1499
01:00:37,750 --> 01:00:34,640
lander that we hope to launch in around

1500
01:00:40,150 --> 01:00:37,760
26 to 28 2026 to 2028

1501
01:00:41,190 --> 01:00:40,160
and that lander it'll be an american

1502
01:00:43,270 --> 01:00:41,200
lander carrying

1503
01:00:44,789 --> 01:00:43,280
a fetch rover that's provided by

1504
01:00:46,630 --> 01:00:44,799
european space agency

1505
01:00:48,549 --> 01:00:46,640
and that little fetch rover will drive

1506
01:00:51,270 --> 01:00:48,559
out and pick up the samples that

1507
01:00:52,710 --> 01:00:51,280
perseverance left on the surface of mars

1508
01:00:55,030 --> 01:00:52,720
and the fetch river will bring them back

1509
01:00:56,630 --> 01:00:55,040
and load them into a rocket that we call

1510
01:00:58,309 --> 01:00:56,640
the mars ascent vehicle which will be

1511
01:00:59,270 --> 01:00:58,319
the first ever launch from another

1512
01:01:01,190 --> 01:00:59,280
planet

1513
01:01:02,710 --> 01:01:01,200

and it will launch those samples into

1514
01:01:05,109 --> 01:01:02,720
orbit around mars

1515
01:01:05,910 --> 01:01:05,119
in the meantime european space agency

1516
01:01:08,470 --> 01:01:05,920
will have an

1517
01:01:11,349 --> 01:01:08,480
orbiter that's in orbit around mars that

1518
01:01:13,670 --> 01:01:11,359
can rendezvous and capture those samples

1519
01:01:15,510 --> 01:01:13,680
and then bring them back to earth for

1520
01:01:18,549 --> 01:01:15,520
for us to study back here in our

1521
01:01:21,190 --> 01:01:18,559
amazing laboratories

1522
01:01:23,589 --> 01:01:21,200
a lot of firsts it sounds like lori and

1523
01:01:25,430 --> 01:01:23,599
another first how is perseverance and

1524
01:01:27,589 --> 01:01:25,440
the mars sample return mission

1525
01:01:29,750 --> 01:01:27,599
going to help the future exploration

1526
01:01:31,589 --> 01:01:29,760
human exploration of mars

1527
01:01:33,589 --> 01:01:31,599
i'm so glad you asked that i think we're

1528
01:01:36,390 --> 01:01:33,599
going to get a lot of

1529
01:01:36,870 --> 01:01:36,400
great information from our sample return

1530
01:01:39,270 --> 01:01:36,880
with

1531
01:01:41,270 --> 01:01:39,280
again being able to land uh the heaviest

1532
01:01:43,190 --> 01:01:41,280
payload we've ever landed on mars will

1533
01:01:44,069 --> 01:01:43,200
be that sample return lander that's

1534
01:01:45,990 --> 01:01:44,079
critical

1535
01:01:47,750 --> 01:01:46,000
to us learning how to land humans on

1536
01:01:49,190 --> 01:01:47,760
mars and then we are definitely going to

1537
01:01:51,190 --> 01:01:49,200
want to be able to launch the humans

1538
01:01:51,990 --> 01:01:51,200

back off of mars so that mars ascent

1539
01:01:54,230 --> 01:01:52,000
vehicle is going

1540
01:01:55,349 --> 01:01:54,240
to be critical that that first step of

1541
01:01:58,789 --> 01:01:55,359
the first launch from

1542
01:02:00,710 --> 01:01:58,799
another planet so exciting

1543
01:02:02,789 --> 01:02:00,720
laurie and speaking about the mars

1544
01:02:03,670 --> 01:02:02,799
generation we're now going to take a

1545
01:02:07,670 --> 01:02:03,680
student question

1546
01:02:08,789 --> 01:02:07,680
for you from livia hi my name is olivia

1547
01:02:11,750 --> 01:02:08,799
and my question

1548
01:02:13,430 --> 01:02:11,760
is what made you want to study mars and

1549
01:02:16,150 --> 01:02:13,440
why are you working so hard

1550
01:02:19,270 --> 01:02:16,160
and willing to wait so long for a sample

1551
01:02:22,630 --> 01:02:21,829
olivia that is such a great question um

1552
01:02:24,870 --> 01:02:22,640
and and i

1553
01:02:27,270 --> 01:02:24,880
enjoy mars just because it can tell us

1554
01:02:29,430 --> 01:02:27,280
so much about how our solar system

1555
01:02:30,870 --> 01:02:29,440
formed and evolved um all of the planets

1556
01:02:32,950 --> 01:02:30,880
can tell us different parts of that

1557
01:02:33,670 --> 01:02:32,960
story and mars is a really key piece of

1558
01:02:35,029 --> 01:02:33,680
that

1559
01:02:37,270 --> 01:02:35,039
and one of the main reasons we're

1560
01:02:37,829 --> 01:02:37,280
willing to wait so long to get the

1561
01:02:40,230 --> 01:02:37,839
sample

1562
01:02:42,150 --> 01:02:40,240
back is that we've got great new

1563
01:02:43,270 --> 01:02:42,160

scientists that are all about your age

1564
01:02:45,589 --> 01:02:43,280
and in about

1565
01:02:47,510 --> 01:02:45,599
10 or 15 or 20 years you'll be the

1566
01:02:47,990 --> 01:02:47,520
generation that's going to actually get

1567
01:02:50,230 --> 01:02:48,000
to work

1568
01:02:51,270 --> 01:02:50,240
with these samples when when they come

1569
01:02:53,589 --> 01:02:51,280
back you'll be

1570
01:02:54,630 --> 01:02:53,599
the scientists and engineers that will

1571
01:02:57,029 --> 01:02:54,640
will be the

1572
01:02:58,069 --> 01:02:57,039
the next generation to to change how we

1573
01:03:02,470 --> 01:02:58,079
think about

1574
01:03:04,710 --> 01:03:02,480
in the solar system

1575
01:03:05,670 --> 01:03:04,720
that was a great question lori reach for

1576
01:03:08,069 --> 01:03:05,680
the stars

1577
01:03:09,670 --> 01:03:08,079
future little scientists and engineers

1578
01:03:11,190 --> 01:03:09,680
thank you so much for joining us here

1579
01:03:13,190 --> 01:03:11,200
today lori it's my pleasure

1580
01:03:14,630 --> 01:03:13,200
thanks back to you raquel for another

1581
01:03:16,870 --> 01:03:14,640
mission update

1582
01:03:19,029 --> 01:03:16,880
thanks marina the cruise team for

1583
01:03:20,230 --> 01:03:19,039
perseverance controls the rover on its

1584
01:03:22,789 --> 01:03:20,240
way to mars

1585
01:03:24,309 --> 01:03:22,799
and moments ago they handed it over to

1586
01:03:26,150 --> 01:03:24,319
the landing team

1587
01:03:28,309 --> 01:03:26,160
and it looks like team leaders in

1588
01:03:28,789 --> 01:03:28,319

mission control are about to talk to

1589
01:03:32,470 --> 01:03:28,799
both

1590
01:03:35,029 --> 01:03:32,480
teams so let's listen in uh the cbm

1591
01:03:37,349 --> 01:03:35,039
change as i mentioned previously is to

1592
01:03:37,829 --> 01:03:37,359
the edl reserve two-way non-coherent

1593
01:03:41,190 --> 01:03:37,839
round

1594
01:03:46,309 --> 01:03:41,200
activity copy flight

1595
01:03:51,029 --> 01:03:49,270
pep talk i guess to the team all right

1596
01:03:51,589 --> 01:03:51,039
uh you know i'm terrible pep talks i

1597
01:03:55,430 --> 01:03:51,599
think you

1598
01:03:56,789 --> 01:03:55,440
my reputation precedes me there and uh

1599
01:03:58,150 --> 01:03:56,799
look i know this hasn't been easy right

1600
01:03:59,589 --> 01:03:58,160
i'm not even sure we've even been all in

1601
01:04:01,109 --> 01:03:59,599
the same room at the same time i mean

1602
01:04:03,910 --> 01:04:01,119
i'm staring at folks across the

1603
01:04:07,829 --> 01:04:03,920
uh across the internet as well even now

1604
01:04:13,349 --> 01:04:11,190
yeah voice check okay

1605
01:04:15,510 --> 01:04:13,359
um i do want to just extend uh my

1606
01:04:17,829 --> 01:04:15,520
heartfelt appreciation from the edl team

1607
01:04:19,270 --> 01:04:17,839
to the uh to the launch cruise team uh

1608
01:04:20,069 --> 01:04:19,280
you've done everything we've asked for

1609
01:04:22,069 --> 01:04:20,079
right i mean

1610
01:04:23,190 --> 01:04:22,079
you've battled anomalies you've you know

1611
01:04:23,910 --> 01:04:23,200
dealt with cessies you've done

1612
01:04:26,069 --> 01:04:23,920
everything

1613
01:04:27,670 --> 01:04:26,079

uh he delivered a healthy spacecraft uh

1614
01:04:29,270 --> 01:04:27,680
to the place that we want to go

1615
01:04:30,470 --> 01:04:29,280
um and she's right on target right we

1616
01:04:31,510 --> 01:04:30,480
did the last maneuver literally two

1617
01:04:33,029 --> 01:04:31,520
months ago

1618
01:04:35,190 --> 01:04:33,039
right this is pretty incredible in my

1619
01:04:36,390 --> 01:04:35,200
opinion um and she's armed with the

1620
01:04:37,910 --> 01:04:36,400
right information to help us land you

1621
01:04:38,230 --> 01:04:37,920
know doing the parameter update last

1622
01:04:39,589 --> 01:04:38,240
night

1623
01:04:41,589 --> 01:04:39,599
we're ready to roll you've done

1624
01:04:43,029 --> 01:04:41,599
everything right um and you've put up

1625
01:04:44,630 --> 01:04:43,039
with us too right you've put up with our

1626
01:04:46,630 --> 01:04:44,640
eccentricities and

1627
01:04:48,549 --> 01:04:46,640
the things we like to do in edl land so

1628
01:04:50,470 --> 01:04:48,559
i very much appreciate that

1629
01:04:51,670 --> 01:04:50,480
so uh you all should sleep in on friday

1630
01:04:54,549 --> 01:04:51,680
since uh

1631
01:04:55,910 --> 01:04:54,559
i you know you guys have earned it um

1632
01:04:57,029 --> 01:04:55,920
thanks for literally and figuratively

1633
01:04:57,910 --> 01:04:57,039
putting us in the right position to

1634
01:05:01,349 --> 01:04:57,920
succeed

1635
01:05:04,870 --> 01:05:01,359
and uh let's land on mars together

1636
01:05:06,230 --> 01:05:04,880
copy edl phase and uh as flight director

1637
01:05:07,349 --> 01:05:06,240
i also would like to thank the whole

1638
01:05:10,390 --> 01:05:07,359

team

1639
01:05:13,750 --> 01:05:10,400
cruise ops edl ops

1640
01:05:15,670 --> 01:05:13,760
edl team and the surface ops as well

1641
01:05:17,510 --> 01:05:15,680
it's been an amazing journey i think we

1642
01:05:19,109 --> 01:05:17,520
all know that and

1643
01:05:22,150 --> 01:05:19,119
it's been my honor and pleasure to work

1644
01:05:23,349 --> 01:05:22,160
with you all side by side and your

1645
01:05:26,069 --> 01:05:23,359
tireless efforts

1646
01:05:27,910 --> 01:05:26,079
and endurance in the face of our

1647
01:05:31,990 --> 01:05:27,920
challenges has been

1648
01:05:34,390 --> 01:05:32,000
truly truly inspiring so kudos to you

1649
01:05:36,390 --> 01:05:34,400
mission would you like to see something

1650
01:05:38,470 --> 01:05:36,400
yeah just echoing the same words that

1651
01:05:39,510 --> 01:05:38,480
uh that al and magdy have uh have

1652
01:05:41,750 --> 01:05:39,520
mentioned

1653
01:05:43,750 --> 01:05:41,760
you guys have overcome great obstacles

1654
01:05:45,829 --> 01:05:43,760
in the last six and a half months and it

1655
01:05:46,789 --> 01:05:45,839
started with an earthquake in this room

1656
01:05:49,990 --> 01:05:46,799
on launch day

1657
01:05:52,230 --> 01:05:50,000
at l minus 20 minutes so i

1658
01:05:53,750 --> 01:05:52,240
can't be more proud than all of the

1659
01:05:55,750 --> 01:05:53,760
achievements that you guys have

1660
01:05:57,029 --> 01:05:55,760
have pulled off in the last six and a

1661
01:05:59,109 --> 01:05:57,039
half months

1662
01:06:00,870 --> 01:05:59,119
whatever happens in the next hour and a

1663
01:06:02,069 --> 01:06:00,880

half you can be proud of the

1664
01:06:04,230 --> 01:06:02,079
achievements that you've

1665
01:06:06,069 --> 01:06:04,240
accomplished so far i look forward to

1666
01:06:07,589 --> 01:06:06,079
seeing you on the other side

1667
01:06:09,109 --> 01:06:07,599
and i only wish that the rest of our

1668
01:06:09,670 --> 01:06:09,119
team could be sharing this moment with

1669
01:06:14,309 --> 01:06:09,680
us

1670
01:06:16,549 --> 01:06:14,319
is only as half as full

1671
01:06:17,750 --> 01:06:16,559
as it would be if we weren't in this

1672
01:06:19,589 --> 01:06:17,760
pandemic so

1673
01:06:21,430 --> 01:06:19,599
missing everybody on the team who's not

1674
01:06:35,029 --> 01:06:21,440
with us here today

1675
01:06:35,039 --> 01:06:40,470
and with that godspeed perseverance

1676
01:06:44,710 --> 01:06:43,430
all right activity go ahead and continue

1677
01:06:47,190 --> 01:06:44,720
the report

1678
01:06:49,109 --> 01:06:47,200
sure thing flight we've since completed

1679
01:06:51,510 --> 01:06:49,119
the edl start anchor

1680
01:06:53,670 --> 01:06:51,520
um as i was mentioning we changed our

1681
01:06:55,029 --> 01:06:53,680
cbm row to edl reserve two-way

1682
01:06:57,510 --> 01:06:55,039
non-coherent

1683
01:06:58,870 --> 01:06:57,520
that row reinforces our cbm windows

1684
01:07:01,190 --> 01:06:58,880
disabled

1685
01:07:02,630 --> 01:07:01,200
keeps our packetization on it turns off

1686
01:07:03,589 --> 01:07:02,640
our ranging and switches to the

1687
01:07:05,910 --> 01:07:03,599
auxiliary

1688
01:07:07,750 --> 01:07:05,920

oscillator we have also started our

1689
01:07:10,789 --> 01:07:07,760
real-time data product

1690
01:07:13,589 --> 01:07:10,799
and reinforced medley on

1691
01:07:15,109 --> 01:07:13,599
at this time we now we just heard

1692
01:07:17,670 --> 01:07:15,119
perseverance team leaders

1693
01:07:19,510 --> 01:07:17,680
thank the cruise team for their work in

1694
01:07:22,309 --> 01:07:19,520
guiding the rover to mars

1695
01:07:24,870 --> 01:07:22,319
now did you know the rover name and mars

1696
01:07:27,349 --> 01:07:24,880
helicopter name came from students

1697
01:07:30,069 --> 01:07:27,359
well a couple weeks ago marina was able

1698
01:07:32,950 --> 01:07:30,079
to catch up with them

1699
01:07:35,270 --> 01:07:32,960
thanks raquel earlier this year nasa and

1700
01:07:36,470 --> 01:07:35,280
our partners held a nationwide essay

1701
01:07:39,910 --> 01:07:36,480
contest to name

1702
01:07:41,829 --> 01:07:39,920
our mars rover alex mather a 7th grader

1703
01:07:43,829 --> 01:07:41,839
from springfield virginia

1704
01:07:46,150 --> 01:07:43,839
submitted the winning essay that was

1705
01:07:46,549 --> 01:07:46,160
selected by nasa from a field of more

1706
01:07:50,069 --> 01:07:46,559
than

1707
01:07:52,470 --> 01:07:50,079
28 000 entries from k through 12

1708
01:07:54,950 --> 01:07:52,480
students in every state in the u.s

1709
01:07:56,470 --> 01:07:54,960
vanissa roupani's essay for ingenuity

1710
01:07:58,470 --> 01:07:56,480
was so compelling

1711
01:08:00,630 --> 01:07:58,480
nasa thought it would be a perfect name

1712
01:08:02,630 --> 01:08:00,640
for the history-making helicopter

1713
01:08:04,710 --> 01:08:02,640

a technology demonstration carried

1714
01:08:07,270 --> 01:08:04,720
aboard the perseverance rover

1715
01:08:08,069 --> 01:08:07,280
alex and vanessa join us now welcome you

1716
01:08:12,630 --> 01:08:08,079
guys

1717
01:08:14,789 --> 01:08:12,640
hello space nerds hi

1718
01:08:15,670 --> 01:08:14,799
now you got to go to florida and watch

1719
01:08:18,390 --> 01:08:15,680
the launch

1720
01:08:20,229 --> 01:08:18,400
live back in july alex what were you

1721
01:08:21,590 --> 01:08:20,239
feeling as you saw that rocket launched

1722
01:08:23,910 --> 01:08:21,600
into the sky

1723
01:08:25,189 --> 01:08:23,920
i read a lot of books written by

1724
01:08:27,669 --> 01:08:25,199
astronauts and

1725
01:08:28,470 --> 01:08:27,679
every single one of them always talks

1726
01:08:32,390 --> 01:08:28,480
about

1727
01:08:34,550 --> 01:08:32,400
the raw power behind the space launch

1728
01:08:35,829 --> 01:08:34,560
and i definitely feel like watching the

1729
01:08:39,189 --> 01:08:35,839
launch invoked

1730
01:08:42,309 --> 01:08:39,199
that sense of of well

1731
01:08:44,630 --> 01:08:42,319
inspiration mixed with anticipation

1732
01:08:47,430 --> 01:08:44,640
along with that rumble in my chest

1733
01:08:49,590 --> 01:08:47,440
that's very inspirational and i'm sure

1734
01:08:51,430 --> 01:08:49,600
that you have had many conversations

1735
01:08:52,149 --> 01:08:51,440
with your classmates since this all

1736
01:08:53,430 --> 01:08:52,159
began now

1737
01:08:56,550 --> 01:08:53,440
what kind of questions have they asked

1738
01:08:58,709 --> 01:08:56,560

you i got some people asking me about

1739
01:09:00,630 --> 01:08:58,719
what this helicopter is what this rover

1740
01:09:02,630 --> 01:09:00,640
is what are they actually going to do

1741
01:09:03,990 --> 01:09:02,640
so i love that this whole experience

1742
01:09:05,590 --> 01:09:04,000
sparked a greater interest in the

1743
01:09:07,430 --> 01:09:05,600
mission in my community

1744
01:09:10,550 --> 01:09:07,440
why do you think it's so important for

1745
01:09:13,749 --> 01:09:10,560
kids to be inspired by space exploration

1746
01:09:14,789 --> 01:09:13,759
because space is the future and kids are

1747
01:09:16,950 --> 01:09:14,799
the future

1748
01:09:17,829 --> 01:09:16,960
learning about space and watching the

1749
01:09:20,630 --> 01:09:17,839
story of

1750
01:09:22,550 --> 01:09:20,640
humanity spread to the stars happen is

1751
01:09:25,829 --> 01:09:22,560
watching the future happen

1752
01:09:26,390 --> 01:09:25,839
and seeing history unfold the best way

1753
01:09:28,229 --> 01:09:26,400
to

1754
01:09:29,749 --> 01:09:28,239
keep our homes safe and protect our

1755
01:09:30,550 --> 01:09:29,759
planet is to learn from the worlds

1756
01:09:32,070 --> 01:09:30,560
around it

1757
01:09:33,749 --> 01:09:32,080
so i think it's really important for the

1758
01:09:35,430 --> 01:09:33,759
next generation of scientists to be

1759
01:09:38,390 --> 01:09:35,440
engaged in that type of exploration to

1760
01:09:40,789 --> 01:09:38,400
make our home the best place it can be

1761
01:09:41,829 --> 01:09:40,799
now speaking of the future what has your

1762
01:09:44,229 --> 01:09:41,839
life been like since

1763
01:09:46,390 --> 01:09:44,239

naming the rover and helicopter has it

1764
01:09:48,390 --> 01:09:46,400
sparked any future aspirations for the

1765
01:09:51,510 --> 01:09:48,400
two of you

1766
01:09:53,669 --> 01:09:51,520
oh man i am currently applying to a

1767
01:09:54,550 --> 01:09:53,679
science and technology school for high

1768
01:09:56,709 --> 01:09:54,560
school

1769
01:09:58,070 --> 01:09:56,719
i'm hoping for a nasa internship

1770
01:10:00,950 --> 01:09:58,080
sometime along the way

1771
01:10:02,630 --> 01:10:00,960
with my ultimate goal being to join the

1772
01:10:03,510 --> 01:10:02,640
incredible team of scientists and

1773
01:10:06,149 --> 01:10:03,520
engineers

1774
01:10:07,990 --> 01:10:06,159
who are about to make this happen this

1775
01:10:09,510 --> 01:10:08,000
whole experience has definitely shown me

1776
01:10:10,310 --> 01:10:09,520
that i want to go into the space

1777
01:10:11,990 --> 01:10:10,320
industry

1778
01:10:13,350 --> 01:10:12,000
i came home from florida did all my

1779
01:10:15,750 --> 01:10:13,360
college applications and checked

1780
01:10:17,189 --> 01:10:15,760
aerospace engineering on all the boxes

1781
01:10:18,630 --> 01:10:17,199
i mean the whole time we were there i

1782
01:10:20,390 --> 01:10:18,640
was thinking why would anyone want to do

1783
01:10:23,590 --> 01:10:20,400
anything else

1784
01:10:24,070 --> 01:10:23,600
so true and the best of luck to both of

1785
01:10:28,390 --> 01:10:24,080
you

1786
01:10:30,229 --> 01:10:28,400
today alex and vanessa

1787
01:10:32,229 --> 01:10:30,239
thank you for having us thank you so

1788
01:10:36,470 --> 01:10:32,239

much i had a great time

1789
01:10:38,709 --> 01:10:36,480
now your essays as well as the top 155

1790
01:10:40,149 --> 01:10:38,719
finalist essays are riding on the

1791
01:10:42,630 --> 01:10:40,159
perseverance rover

1792
01:10:43,350 --> 01:10:42,640
along with nearly 11 million of the

1793
01:10:45,750 --> 01:10:43,360
names from

1794
01:10:46,709 --> 01:10:45,760
all over the world that were submitted

1795
01:10:48,630 --> 01:10:46,719
before launch

1796
01:10:50,870 --> 01:10:48,640
and if you miss the chance to get your

1797
01:10:52,790 --> 01:10:50,880
name on perseverance then you will get

1798
01:10:54,149 --> 01:10:52,800
another chance to reserve a spot on the

1799
01:10:56,830 --> 01:10:54,159
next mission to mars

1800
01:10:58,390 --> 01:10:56,840
so make sure that you sign up now at

1801
01:11:01,990 --> 01:10:58,400
mars.nasa.gov

1802
01:11:05,510 --> 01:11:04,229
as virtual celebrations are happening

1803
01:11:07,270 --> 01:11:05,520
all over the globe

1804
01:11:09,750 --> 01:11:07,280
let's take a look at some of your

1805
01:11:11,910 --> 01:11:09,760
submissions on our social channels

1806
01:11:13,750 --> 01:11:11,920
showing us how you're celebrating the

1807
01:11:17,189 --> 01:11:13,760
perseverance landing

1808
01:11:20,310 --> 01:11:17,199
right now and remember to hashtag

1809
01:11:23,669 --> 01:11:20,320
count down to mars and send those in we

1810
01:11:26,310 --> 01:11:23,679
would love to show them off

1811
01:11:27,110 --> 01:11:26,320
look at these kids they are getting so

1812
01:11:28,870 --> 01:11:27,120
excited

1813
01:11:31,189 --> 01:11:28,880

everyone's watching it a lot of

1814
01:11:31,910 --> 01:11:31,199
classrooms are watching it oh and great

1815
01:11:35,030 --> 01:11:31,920
someone

1816
01:11:35,430 --> 01:11:35,040
did a lego version of perseverance which

1817
01:11:38,630 --> 01:11:35,440
is

1818
01:11:40,310 --> 01:11:38,640
awesome it looks fantastic we love

1819
01:11:42,229 --> 01:11:40,320
getting all your pictures out there

1820
01:11:44,070 --> 01:11:42,239
we've gotten a lot of artwork from kids

1821
01:11:46,070 --> 01:11:44,080
which has been great i know i have a

1822
01:11:48,149 --> 01:11:46,080
nine-year-old john at home and he loves

1823
01:11:50,149 --> 01:11:48,159
to draw the rover

1824
01:11:51,669 --> 01:11:50,159
and look at that that is awesome that's

1825
01:11:52,149 --> 01:11:51,679
better than anything i could bake that's

1826
01:11:55,270 --> 01:11:52,159
for sure

1827
01:11:56,310 --> 01:11:55,280
perseverance in a cake that looks so

1828
01:11:59,510 --> 01:11:56,320
great delicious

1829
01:12:05,830 --> 01:12:02,709
another great send-in from david bowie

1830
01:12:09,270 --> 01:12:07,350
thank you so much for your submissions

1831
01:12:11,030 --> 01:12:09,280
remember hashtag countdown to mars we

1832
01:12:12,950 --> 01:12:11,040
love to see how you're celebrating

1833
01:12:14,950 --> 01:12:12,960
now you might know our next guest from

1834
01:12:17,669 --> 01:12:14,960
shows like emily's wonderlab

1835
01:12:18,310 --> 01:12:17,679
joining me now is emily kelandrelli

1836
01:12:21,510 --> 01:12:18,320
thank you

1837
01:12:24,149 --> 01:12:21,520
so much for being here with us today

1838
01:12:26,229 --> 01:12:24,159

hi thanks so much for having me now you

1839
01:12:27,910 --> 01:12:26,239
are very passionate about getting kids

1840
01:12:28,950 --> 01:12:27,920
interested in science and space

1841
01:12:31,270 --> 01:12:28,960
exploration

1842
01:12:33,350 --> 01:12:31,280
why do you think kids are so excited

1843
01:12:35,270 --> 01:12:33,360
about space

1844
01:12:36,950 --> 01:12:35,280
well i know the reason i'm excited about

1845
01:12:38,870 --> 01:12:36,960
space and i think it's the same reason

1846
01:12:39,590 --> 01:12:38,880
that many others are excited about space

1847
01:12:41,990 --> 01:12:39,600
and it's that

1848
01:12:43,110 --> 01:12:42,000
the people in the space industry work to

1849
01:12:45,189 --> 01:12:43,120
answer two

1850
01:12:46,470 --> 01:12:45,199
of the biggest questions that humans

1851
01:12:49,030 --> 01:12:46,480
have ever asked

1852
01:12:50,630 --> 01:12:49,040
are we alone in the universe and where

1853
01:12:52,790 --> 01:12:50,640
did we all come from

1854
01:12:54,310 --> 01:12:52,800
and by sending a rover to mars we are

1855
01:12:56,470 --> 01:12:54,320
gaining evidence

1856
01:12:58,470 --> 01:12:56,480
for the answers to these questions more

1857
01:13:01,350 --> 01:12:58,480
evidence than we ever had before and i

1858
01:13:03,270 --> 01:13:01,360
think that's so exciting

1859
01:13:05,270 --> 01:13:03,280
it is and i know you get loads of

1860
01:13:07,910 --> 01:13:05,280
interesting questions from kids have you

1861
01:13:10,310 --> 01:13:07,920
gotten any about mars specifically

1862
01:13:11,510 --> 01:13:10,320
oh my gosh yes everybody loves smarts

1863
01:13:13,510 --> 01:13:11,520

it's in movies and

1864
01:13:15,110 --> 01:13:13,520
books and tv shows and everybody loves

1865
01:13:16,709 --> 01:13:15,120
mars so one of the things that i get

1866
01:13:17,990 --> 01:13:16,719
asked a lot is that you know it's called

1867
01:13:20,550 --> 01:13:18,000
the red planet

1868
01:13:21,750 --> 01:13:20,560
why is it red well it's red because it's

1869
01:13:24,709 --> 01:13:21,760
literally rusty

1870
01:13:25,910 --> 01:13:24,719
the top layer of soil on mars has iron

1871
01:13:28,149 --> 01:13:25,920
oxide in it or

1872
01:13:29,430 --> 01:13:28,159
rust and rust has that brownish red

1873
01:13:31,910 --> 01:13:29,440
color so it's it's

1874
01:13:32,550 --> 01:13:31,920
red because it's rusty and also because

1875
01:13:35,189 --> 01:13:32,560
it's red

1876
01:13:35,910 --> 01:13:35,199
they ask is it red hot is it really hot

1877
01:13:38,070 --> 01:13:35,920
on mars

1878
01:13:39,910 --> 01:13:38,080
and well no actually it's colder than

1879
01:13:41,270 --> 01:13:39,920
the earth it's farther away from the sun

1880
01:13:42,630 --> 01:13:41,280
so as you would imagine it's a little

1881
01:13:45,350 --> 01:13:42,640
bit colder than the earth

1882
01:13:46,870 --> 01:13:45,360
it also has a really thin atmosphere so

1883
01:13:49,430 --> 01:13:46,880
the heat that it does have

1884
01:13:50,470 --> 01:13:49,440
it has a hard time keeping in um and so

1885
01:13:52,390 --> 01:13:50,480
it's a little bit colder

1886
01:13:54,550 --> 01:13:52,400
but then i also get asked what would i

1887
01:13:55,110 --> 01:13:54,560
weigh on mars that's a really fun

1888
01:13:57,510 --> 01:13:55,120

question

1889
01:13:59,270 --> 01:13:57,520
so on mars it's a little bit smaller

1890
01:14:00,149 --> 01:13:59,280
than the earth so the gravity there is

1891
01:14:01,750 --> 01:14:00,159
weaker it's about

1892
01:14:03,590 --> 01:14:01,760
three-eighths the gravity that we have

1893
01:14:05,189 --> 01:14:03,600
here on earth so if you wait a hundred

1894
01:14:07,270 --> 01:14:05,199
pounds here on earth you'd weigh 38

1895
01:14:07,669 --> 01:14:07,280
pounds on mars or 100 kilograms here on

1896
01:14:10,790 --> 01:14:07,679
earth

1897
01:14:12,470 --> 01:14:10,800
38 kilograms on mars

1898
01:14:13,990 --> 01:14:12,480
those are all super fun i think even

1899
01:14:15,910 --> 01:14:14,000
some adults want to know the answers to

1900
01:14:17,830 --> 01:14:15,920
those questions emily

1901
01:14:19,830 --> 01:14:17,840
now why do you think it's so important

1902
01:14:22,870 --> 01:14:19,840
to educate kids about science and

1903
01:14:25,990 --> 01:14:22,880
give them that great foundation

1904
01:14:27,669 --> 01:14:26,000
well science is the language of nature

1905
01:14:28,229 --> 01:14:27,679
and learning about science and learning

1906
01:14:30,310 --> 01:14:28,239
how to

1907
01:14:32,070 --> 01:14:30,320
think like a scientist means you are

1908
01:14:34,470 --> 01:14:32,080
learning how to systematically

1909
01:14:36,149 --> 01:14:34,480
seek out truth in the world you are

1910
01:14:37,910 --> 01:14:36,159
learning the scientific method you're

1911
01:14:40,070 --> 01:14:37,920
learning how to be a critical thinker

1912
01:14:41,590 --> 01:14:40,080
and honestly those skills are great for

1913
01:14:42,790 --> 01:14:41,600

whatever you end up wanting to do in

1914
01:14:44,630 --> 01:14:42,800
life

1915
01:14:46,950 --> 01:14:44,640
true if you want to be a scientist or an

1916
01:14:49,669 --> 01:14:46,960
opera singer that holds true what are

1917
01:14:52,870 --> 01:14:49,679
you most excited about today

1918
01:14:55,030 --> 01:14:52,880
i mean humans are launching a robot to

1919
01:14:56,950 --> 01:14:55,040
mars that doesn't happen every day i

1920
01:14:58,870 --> 01:14:56,960
think in all of the hecticness that is

1921
01:15:00,630 --> 01:14:58,880
going on today and all of the nerves

1922
01:15:03,270 --> 01:15:00,640
i just hope everyone can take a moment

1923
01:15:03,910 --> 01:15:03,280
to sit back and remember that we live in

1924
01:15:05,990 --> 01:15:03,920
a time

1925
01:15:07,669 --> 01:15:06,000
when humans have the ability to send a

1926
01:15:11,030 --> 01:15:07,679
robot to another planet

1927
01:15:13,830 --> 01:15:11,040
and that is just that's so cool to me

1928
01:15:16,070 --> 01:15:13,840
it is very cool emily take a deep breath

1929
01:15:18,070 --> 01:15:16,080
thanks for joining us here

1930
01:15:19,669 --> 01:15:18,080
thanks for having me sending it back to

1931
01:15:22,950 --> 01:15:19,679
you now raquel

1932
01:15:23,990 --> 01:15:22,960
thanks marina we are offering lots of

1933
01:15:26,630 --> 01:15:24,000
ways to ride along

1934
01:15:27,750 --> 01:15:26,640
with us to mars now put yourself right

1935
01:15:30,390 --> 01:15:27,760
into the action now

1936
01:15:32,229 --> 01:15:30,400
with our perseverance photo booth you

1937
01:15:34,709 --> 01:15:32,239
can pose next to the rover

1938
01:15:36,630 --> 01:15:34,719

place yourself in our mission control

1939
01:15:39,350 --> 01:15:36,640
and even see what you might look like

1940
01:15:41,270 --> 01:15:39,360
taking a selfie on the red planet

1941
01:15:43,510 --> 01:15:41,280
there you'll also have a chance to sign

1942
01:15:46,229 --> 01:15:43,520
up to send your name to mars on nasa's

1943
01:15:47,950 --> 01:15:46,239
next flight to the red planet it's all

1944
01:15:50,390 --> 01:15:47,960
available at

1945
01:15:54,390 --> 01:15:50,400
go.nasa.gov mars

1946
01:15:57,430 --> 01:15:54,400
2020 toolkit and joining us now

1947
01:15:57,990 --> 01:15:57,440
is jpl chief engineer and landing

1948
01:16:00,709 --> 01:15:58,000
veteran

1949
01:16:01,830 --> 01:16:00,719
rob manning he will be breaking down key

1950
01:16:04,149 --> 01:16:01,840
moments coming up

1951
01:16:06,790 --> 01:16:04,159
and very few people know more about

1952
01:16:10,310 --> 01:16:06,800
landing on mars than rob going back to

1953
01:16:12,709 --> 01:16:10,320
the pathfinder mission in 1997.

1954
01:16:14,310 --> 01:16:12,719
thanks for joining us today rob thank

1955
01:16:16,630 --> 01:16:14,320
you very much raquel for

1956
01:16:17,830 --> 01:16:16,640
for having me here and what a wonderful

1957
01:16:19,750 --> 01:16:17,840
experience

1958
01:16:21,350 --> 01:16:19,760
what a wonderful day for a beautiful day

1959
01:16:23,270 --> 01:16:21,360
in california

1960
01:16:24,470 --> 01:16:23,280
we we're just all so excited here

1961
01:16:27,110 --> 01:16:24,480
anxious worried

1962
01:16:29,030 --> 01:16:27,120
but very hopeful rob i have a question

1963
01:16:29,990 --> 01:16:29,040

for you there is a landing tradition at

1964
01:16:32,870 --> 01:16:30,000
jpl that

1965
01:16:34,870 --> 01:16:32,880
involves eating peanuts for good luck

1966
01:16:37,270 --> 01:16:34,880
can you tell us how did that start

1967
01:16:38,310 --> 01:16:37,280
yes it started in the in the mid 1960s

1968
01:16:40,550 --> 01:16:38,320
what happened was

1969
01:16:42,550 --> 01:16:40,560
we had a series of missions that had

1970
01:16:43,990 --> 01:16:42,560
failures the ranger program in the early

1971
01:16:45,910 --> 01:16:44,000
1960s

1972
01:16:47,750 --> 01:16:45,920
one after another failed and what

1973
01:16:49,189 --> 01:16:47,760
happened was one day a fellow by the

1974
01:16:51,750 --> 01:16:49,199
name of dick wallace on the

1975
01:16:52,470 --> 01:16:51,760
on ranger number seven on the seventh

1976
01:16:55,110 --> 01:16:52,480
attempt

1977
01:16:55,990 --> 01:16:55,120
decided to bring peanuts to the ops area

1978
01:16:58,310 --> 01:16:56,000
just before the

1979
01:17:00,149 --> 01:16:58,320
before the launch and guess what that

1980
01:17:02,149 --> 01:17:00,159
mission worked now we're not supposed to

1981
01:17:03,910 --> 01:17:02,159
be too super superstitious we're

1982
01:17:05,750 --> 01:17:03,920
engineers and scientists after all

1983
01:17:07,830 --> 01:17:05,760
but we love tradition and ever since

1984
01:17:09,350 --> 01:17:07,840
then before launch and before critical

1985
01:17:10,709 --> 01:17:09,360
events like enter descent landing we

1986
01:17:11,430 --> 01:17:10,719
have brought out peanuts and shared them

1987
01:17:13,030 --> 01:17:11,440
with the team

1988
01:17:14,470 --> 01:17:13,040

and it's been really a wonderful little

1989
01:17:15,990 --> 01:17:14,480
experience and and so

1990
01:17:17,750 --> 01:17:16,000
this is something we uh we'll do we're

1991
01:17:19,350 --> 01:17:17,760
doing right now and uh

1992
01:17:20,950 --> 01:17:19,360
and it's something that we just can't

1993
01:17:22,310 --> 01:17:20,960
help ourselves it's just part of the

1994
01:17:26,229 --> 01:17:22,320
experience

1995
01:17:27,910 --> 01:17:26,239
did the perseverance team keep the

1996
01:17:29,669 --> 01:17:27,920
tradition alive this year

1997
01:17:31,110 --> 01:17:29,679
well this year we're passed out little

1998
01:17:33,030 --> 01:17:31,120
packets of penis to the team

1999
01:17:34,470 --> 01:17:33,040
and they can sneak a pen one peanut in

2000
01:17:36,390 --> 01:17:34,480
their mouth for uh

2001
01:17:37,990 --> 01:17:36,400
as part of to keep the tradition alive

2002
01:17:40,070 --> 01:17:38,000
but you know this is part of the covet

2003
01:17:42,149 --> 01:17:40,080
experience but we can't leave this one

2004
01:17:43,189 --> 01:17:42,159
undone so this is what we're doing and

2005
01:17:45,669 --> 01:17:43,199
we're and uh

2006
01:17:46,229 --> 01:17:45,679
and this is going to help us land safely

2007
01:17:47,990 --> 01:17:46,239
all right

2008
01:17:49,590 --> 01:17:48,000
thanks rob i have some questions for you

2009
01:17:51,110 --> 01:17:49,600
a little later on but we are heading

2010
01:17:53,350 --> 01:17:51,120
back to swati mohan who

2011
01:17:55,510 --> 01:17:53,360
is part of the landing team she'll be

2012
01:17:56,310 --> 01:17:55,520
calling out key milestone and events as

2013
01:17:58,310 --> 01:17:56,320

they happen

2014
01:18:02,149 --> 01:17:58,320
from mission control so let's listen in

2015
01:18:06,310 --> 01:18:04,070
so right now we're still about 20

2016
01:18:06,870 --> 01:18:06,320
minutes from entry and the edl phase is

2017
01:18:09,990 --> 01:18:06,880
giving

2018
01:18:13,830 --> 01:18:10,000
a last minute

2019
01:18:17,110 --> 01:18:13,840
confirmation of what will be happening

2020
01:18:20,709 --> 01:18:17,120
in the upcoming changes to the vehicle

2021
01:18:25,189 --> 01:18:23,590
and this will allow us to steer our

2022
01:18:26,709 --> 01:18:25,199
trajectory

2023
01:18:28,550 --> 01:18:26,719
as we make our way through the

2024
01:18:31,350 --> 01:18:28,560
atmosphere

2025
01:18:33,350 --> 01:18:31,360
and this is one of the things that

2026
01:18:38,470 --> 01:18:33,360
allowed

2027
01:18:42,790 --> 01:18:40,790
land where it did and we're depending on

2028
01:18:45,189 --> 01:18:42,800
the same type of entry guidance

2029
01:18:48,310 --> 01:18:45,199
this time around to help get us very

2030
01:18:52,070 --> 01:18:51,189
as we make our way through entry finish

2031
01:18:56,229 --> 01:18:52,080
the

2032
01:18:58,630 --> 01:18:56,239
finish our guided entry profile

2033
01:18:59,830 --> 01:18:58,640
we'll do a maneuver called heading

2034
01:19:03,510 --> 01:18:59,840
alignment where we

2035
01:19:06,470 --> 01:19:03,520
point toward the target and get ready to

2036
01:19:08,149 --> 01:19:06,480
deploy the parachute but before we

2037
01:19:11,189 --> 01:19:08,159
deploy the parachute

2038
01:19:14,630 --> 01:19:11,199

we need to get rid of a set

2039
01:19:17,669 --> 01:19:14,640
of balance passes that have been

2040
01:19:19,350 --> 01:19:17,679
giving us a center of gravity or cg

2041
01:19:22,070 --> 01:19:19,360
offset

2042
01:19:23,510 --> 01:19:22,080
throughout the guided entry phase so

2043
01:19:26,470 --> 01:19:23,520
these are called

2044
01:19:28,790 --> 01:19:26,480
the uh the enter balance masses we also

2045
01:19:31,590 --> 01:19:28,800
call this maneuver

2046
01:19:32,790 --> 01:19:31,600
suffer s-u-f-r or straighten up and fly

2047
01:19:36,070 --> 01:19:32,800
right

2048
01:19:39,350 --> 01:19:36,080
so we'll go ahead and eject those masses

2049
01:19:40,470 --> 01:19:39,360
when we get a trigger from the gnc

2050
01:19:42,630 --> 01:19:40,480
system

2051
01:19:44,870 --> 01:19:42,640
telling us that we're at the appropriate

2052
01:19:48,790 --> 01:19:44,880
range to the target to do so

2053
01:19:52,149 --> 01:19:48,800
as soon as we deploy those we will

2054
01:19:54,070 --> 01:19:52,159
no longer have a cg offset and

2055
01:20:00,709 --> 01:19:54,080
we'll be ready to deploy the parachute

2056
01:20:03,990 --> 01:20:02,470
right where the perseverance team is

2057
01:20:07,270 --> 01:20:04,000
sitting now what's

2058
01:20:10,149 --> 01:20:07,280
in store for them as we approach landing

2059
01:20:10,790 --> 01:20:10,159
i'm going to hold here for uh video prep

2060
01:20:20,229 --> 01:20:10,800
as

2061
01:20:23,510 --> 01:20:20,239
that out when it's ready

2062
01:20:37,189 --> 01:20:23,520
copy flip the announcement now

2063
01:20:41,830 --> 01:20:40,229

all right now rob uh you've been right

2064
01:20:42,229 --> 01:20:41,840
where the perseverance team is sitting

2065
01:20:44,709 --> 01:20:42,239
now

2066
01:20:46,390 --> 01:20:44,719
uh what's in store for them as we

2067
01:20:48,790 --> 01:20:46,400
approach landing

2068
01:20:49,830 --> 01:20:48,800
well this is the really this is the nail

2069
01:20:51,750 --> 01:20:49,840
biting time

2070
01:20:53,430 --> 01:20:51,760
um fortunately we still have ones and

2071
01:20:55,350 --> 01:20:53,440
zeros coming but very soon as we

2072
01:20:57,590 --> 01:20:55,360
approach cruise stage separation

2073
01:20:59,030 --> 01:20:57,600
the the transmitter on this rover that's

2074
01:21:02,149 --> 01:20:59,040
been we've been using all the way to get

2075
01:21:04,790 --> 01:21:02,159
to mars is going to be turned off

2076
01:21:06,149 --> 01:21:04,800
so and we will lose our ability to see

2077
01:21:07,590 --> 01:21:06,159
ones and zeros but the good thing

2078
01:21:09,590 --> 01:21:07,600
is once the cruise stage is gone there's

2079
01:21:13,110 --> 01:21:09,600
another radio that will continue

2080
01:21:14,629 --> 01:21:13,120
transmitting uh a tone so that like a

2081
01:21:16,229 --> 01:21:14,639
flashlight that will allow us to see at

2082
01:21:18,229 --> 01:21:16,239
least see that the vehicle is still

2083
01:21:19,669 --> 01:21:18,239
on and that and then and that color of

2084
01:21:20,470 --> 01:21:19,679
that flashlight tells us a little bit

2085
01:21:23,189 --> 01:21:20,480
what state

2086
01:21:25,030 --> 01:21:23,199
this the rover's in but soon after that

2087
01:21:27,030 --> 01:21:25,040
um it won't be very long before

2088
01:21:29,350 --> 01:21:27,040

we'll be able to hear more ones and

2089
01:21:30,870 --> 01:21:29,360
zeros coming from the spacecraft

2090
01:21:32,709 --> 01:21:30,880
so this is a really exciting time and

2091
01:21:33,590 --> 01:21:32,719
and it's just important to remind people

2092
01:21:35,189 --> 01:21:33,600
this is a

2093
01:21:37,030 --> 01:21:35,199
uh there's a lot that can go wrong in a

2094
01:21:39,110 --> 01:21:37,040
day like today there are thousands of

2095
01:21:41,430 --> 01:21:39,120
things that have to go right

2096
01:21:42,229 --> 01:21:41,440
yeah we had success in the past landing

2097
01:21:44,070 --> 01:21:42,239
on mars

2098
01:21:46,550 --> 01:21:44,080
you'd think it gets easier but it really

2099
01:21:48,950 --> 01:21:46,560
doesn't why is it still so difficult

2100
01:21:50,550 --> 01:21:48,960
well it's well because it's involved

2101
01:21:52,229 --> 01:21:50,560
thousands and thousands i think hundreds

2102
01:21:54,790 --> 01:21:52,239
of thousands of lines of code

2103
01:21:56,070 --> 01:21:54,800
we there there is uh there's 79

2104
01:21:59,189 --> 01:21:56,080
pyrotechnic devices

2105
01:22:00,550 --> 01:21:59,199
each have to work perfectly one critical

2106
01:22:02,790 --> 01:22:00,560
wire short or one

2107
01:22:04,870 --> 01:22:02,800
key thing mechanism that doesn't work or

2108
01:22:07,669 --> 01:22:04,880
breaks and it's mission over

2109
01:22:09,590 --> 01:22:07,679
and so it's you know and and so and and

2110
01:22:10,470 --> 01:22:09,600
it's very easy we're human beings we're

2111
01:22:13,430 --> 01:22:10,480
not perfect

2112
01:22:14,229 --> 01:22:13,440
mistakes can be made we each count on

2113
01:22:18,390 --> 01:22:14,239

each other

2114
01:22:21,189 --> 01:22:18,400
to to find our own mistakes and and we

2115
01:22:23,350 --> 01:22:21,199
work very hard to to learn from the

2116
01:22:25,110 --> 01:22:23,360
mistakes of the past

2117
01:22:27,430 --> 01:22:25,120
we've had many failures half remind

2118
01:22:29,990 --> 01:22:27,440
people roughly half little

2119
01:22:31,669 --> 01:22:30,000
around half of the missions to mars over

2120
01:22:33,910 --> 01:22:31,679
history have failed

2121
01:22:35,430 --> 01:22:33,920
um and so it's it's it's that could

2122
01:22:36,390 --> 01:22:35,440
happen today too even though we've had a

2123
01:22:38,550 --> 01:22:36,400
nice wonderful

2124
01:22:39,590 --> 01:22:38,560
string of successes in the united states

2125
01:22:42,790 --> 01:22:39,600
it's still

2126
01:22:43,270 --> 01:22:42,800
a a still a bit of a gamble a gamble

2127
01:22:45,030 --> 01:22:43,280
that we've

2128
01:22:46,470 --> 01:22:45,040
we have hoped that we have we have aired

2129
01:22:48,870 --> 01:22:46,480
in the side of luck

2130
01:22:49,990 --> 01:22:48,880
and and and we've stacked the dice that

2131
01:22:52,470 --> 01:22:50,000
stacked the deck

2132
01:22:53,430 --> 01:22:52,480
and loaded the dice to make this thing

2133
01:22:56,390 --> 01:22:53,440
succeed

2134
01:22:58,149 --> 01:22:56,400
um but um if we do if we do fail and

2135
01:22:59,750 --> 01:22:58,159
something bad happens today

2136
01:23:01,590 --> 01:22:59,760
i can tell you we're going to learn it

2137
01:23:01,990 --> 01:23:01,600
we'll have the data that tell us what

2138
01:23:04,629 --> 01:23:02,000

happened

2139
01:23:05,990 --> 01:23:04,639
we'll know why we'll figure it out and

2140
01:23:08,070 --> 01:23:06,000
and if we

2141
01:23:09,910 --> 01:23:08,080
are allowed we will pick ourselves up

2142
01:23:12,470 --> 01:23:09,920
and get us back on the horse

2143
01:23:13,750 --> 01:23:12,480
and if congress and nasa allow we will

2144
01:23:15,510 --> 01:23:13,760
try again

2145
01:23:17,430 --> 01:23:15,520
as we always do we will learn from our

2146
01:23:19,590 --> 01:23:17,440
mistakes and

2147
01:23:21,430 --> 01:23:19,600
what are the possible scenarios we could

2148
01:23:24,470 --> 01:23:21,440
be looking at today

2149
01:23:25,350 --> 01:23:24,480
well there's things things like uh one

2150
01:23:27,110 --> 01:23:25,360
of the key

2151
01:23:28,550 --> 01:23:27,120
stressful elements for all of us is

2152
01:23:30,149 --> 01:23:28,560
parachute inflation

2153
01:23:31,990 --> 01:23:30,159
uh but just even separating from the

2154
01:23:34,550 --> 01:23:32,000
cruise stage is a pretty major event

2155
01:23:36,790 --> 01:23:34,560
lots of devices have to work properly

2156
01:23:37,910 --> 01:23:36,800
certainly on the heat shield separation

2157
01:23:39,669 --> 01:23:37,920
again getting the

2158
01:23:41,430 --> 01:23:39,679
descent engine started there's no less

2159
01:23:43,990 --> 01:23:41,440
than than uh uh

2160
01:23:45,110 --> 01:23:44,000
16 and rocket motors that have to work

2161
01:23:47,270 --> 01:23:45,120
uh one

2162
01:23:49,189 --> 01:23:47,280
eight to control during entry another

2163
01:23:51,189 --> 01:23:49,199

eight to control it during landing

2164
01:23:52,709 --> 01:23:51,199
i said it's a lot of stuff and it all

2165
01:23:54,870 --> 01:23:52,719
has to work and guess what

2166
01:23:57,110 --> 01:23:54,880
we haven't done this before with this

2167
01:23:58,550 --> 01:23:57,120
vehicle ever this is this first attempt

2168
01:24:00,950 --> 01:23:58,560
to actually land

2169
01:24:02,629 --> 01:24:00,960
we can't try this on earth we can't do

2170
01:24:04,550 --> 01:24:02,639
we don't have test pies to try it out on

2171
01:24:05,830 --> 01:24:04,560
this planet before the big show

2172
01:24:07,189 --> 01:24:05,840
so this vehicle is doing it for the

2173
01:24:08,709 --> 01:24:07,199
first time we've done the best testing

2174
01:24:10,629 --> 01:24:08,719
we can do in bits and pieces

2175
01:24:12,229 --> 01:24:10,639
but you know it's it's as best as we

2176
01:24:14,310 --> 01:24:12,239
could do and and uh

2177
01:24:16,390 --> 01:24:14,320
but i think our team is up to it we've

2178
01:24:18,790 --> 01:24:16,400
this team is the best it's a diverse

2179
01:24:20,149 --> 01:24:18,800
intelligent amazing group of people uh

2180
01:24:21,030 --> 01:24:20,159
people from all over the world who

2181
01:24:22,790 --> 01:24:21,040
worked on this

2182
01:24:24,310 --> 01:24:22,800
not just here in california but all over

2183
01:24:26,470 --> 01:24:24,320
nasa contributors

2184
01:24:27,430 --> 01:24:26,480
from aerospace universities countries

2185
01:24:29,669 --> 01:24:27,440
around the world

2186
01:24:30,870 --> 01:24:29,679
it is just an incredible remarkable

2187
01:24:33,830 --> 01:24:30,880
engineering achievement

2188
01:24:34,790 --> 01:24:33,840

and i am just so proud of this team

2189
01:24:39,830 --> 01:24:34,800
thanks rob now

2190
01:24:44,470 --> 01:24:42,790
all right we're about 14 minutes from

2191
01:24:47,510 --> 01:24:44,480
entry interface

2192
01:24:50,149 --> 01:24:47,520
the vehicle is currently preparing

2193
01:24:51,669 --> 01:24:50,159
the heat rejection system that has kept

2194
01:24:53,510 --> 01:24:51,679
the thermal system cool inside the

2195
01:24:55,030 --> 01:24:53,520
aeroshell for about the last six months

2196
01:24:56,629 --> 01:24:55,040
this will allow the spacecraft to more

2197
01:24:58,790 --> 01:24:56,639
easily cut the line

2198
01:25:07,510 --> 01:24:58,800
in upcoming cruise stage separation

2199
01:25:15,750 --> 01:25:13,110
we have now enabled the rover pyrobus

2200
01:25:16,470 --> 01:25:15,760
that's the pyrotechnic uh system um that

2201
01:25:19,350 --> 01:25:16,480
that was

2202
01:25:20,070 --> 01:25:19,360
powering off the cruise stage devices

2203
01:25:21,350 --> 01:25:20,080
and these are the

2204
01:25:23,110 --> 01:25:21,360
these are the things in the cruise stage

2205
01:25:24,790 --> 01:25:23,120
that will that we no longer need

2206
01:25:26,229 --> 01:25:24,800
with the pyrotechnic system working we

2207
01:25:27,750 --> 01:25:26,239
can you can we can

2208
01:25:29,669 --> 01:25:27,760
explode the devices the vehicle is

2209
01:25:30,470 --> 01:25:29,679
preparing for the upcoming cruise stage

2210
01:25:33,669 --> 01:25:30,480
operation

2211
01:25:36,229 --> 01:25:33,679
in about 3 minutes 15 seconds

2212
01:25:37,830 --> 01:25:36,239
by powering off all the devices on the

2213
01:25:40,310 --> 01:25:37,840

cruise stage in order that

2214
01:25:44,950 --> 01:25:40,320
they can be safe once the cruise stage

2215
01:25:49,510 --> 01:25:47,030
yeah this is a this is a this cruise

2216
01:25:52,070 --> 01:25:49,520
stage has been very reliable

2217
01:25:55,189 --> 01:25:52,080
we are firing our first pyros to vent

2218
01:25:57,110 --> 01:25:55,199
the hrs liquid and gas

2219
01:25:58,390 --> 01:25:57,120
ah this has been the coolant that's kept

2220
01:26:00,070 --> 01:25:58,400
their vehicle from getting too hot in

2221
01:26:05,270 --> 01:26:00,080
the way of mars

2222
01:26:09,189 --> 01:26:07,669
and so this is one of the first major

2223
01:26:11,550 --> 01:26:09,199
events that take place as part of entry

2224
01:26:15,030 --> 01:26:11,560
descent landing

2225
01:26:16,790 --> 01:26:15,040
phrases complete we will see the next

2226
01:26:21,030 --> 01:26:16,800
anchor in approximately

2227
01:26:25,750 --> 01:26:23,189
okay we are currently 12 and a half

2228
01:26:27,270 --> 01:26:25,760
minutes from entry interface

2229
01:26:32,390 --> 01:26:27,280
we are coming up on cruise stage

2230
01:26:36,390 --> 01:26:35,350
what's happening now rob okay just we're

2231
01:26:39,350 --> 01:26:36,400
just waiting the

2232
01:26:40,790 --> 01:26:39,360
the the rover is completely in charge

2233
01:26:42,229 --> 01:26:40,800
it's doing all the things we've taught

2234
01:26:43,430 --> 01:26:42,239
it how to do it's all built into the

2235
01:26:45,590 --> 01:26:43,440
software we've tested it

2236
01:26:46,470 --> 01:26:45,600
over and over and over again this team

2237
01:26:49,189 --> 01:26:46,480
has spent

2238
01:26:50,070 --> 01:26:49,199

24 hours a day seven days a week testing

2239
01:26:53,030 --> 01:26:50,080
this thing

2240
01:26:54,550 --> 01:26:53,040
for years and and and so this is uh this

2241
01:26:56,149 --> 01:26:54,560
is really the culmination of all that

2242
01:26:58,070 --> 01:26:56,159
work so this vehicle is

2243
01:26:59,510 --> 01:26:58,080
is gonna is getting ready to push that

2244
01:27:02,709 --> 01:26:59,520
cruise stage away

2245
01:27:04,629 --> 01:27:02,719
uh once it gets pushed away um it it the

2246
01:27:06,229 --> 01:27:04,639
entry system with the rover inside with

2247
01:27:08,070 --> 01:27:06,239
the rover is still in charge

2248
01:27:10,149 --> 01:27:08,080
it's going to get ready to take the

2249
01:27:10,790 --> 01:27:10,159
vehicle turn it to the right orientation

2250
01:27:19,990 --> 01:27:10,800
and

2251
01:27:24,470 --> 01:27:23,030
this won't be long um be prepared for

2252
01:27:25,030 --> 01:27:24,480
this event taking about a minute and a

2253
01:27:28,550 --> 01:27:25,040
half

2254
01:27:32,550 --> 01:27:28,560
from mistake separation about 11 minutes

2255
01:27:34,790 --> 01:27:32,560
20 seconds from entry interface

2256
01:27:36,390 --> 01:27:34,800
okay so it's about 10 minutes from

2257
01:27:37,510 --> 01:27:36,400
cruising separation until it entering

2258
01:27:41,669 --> 01:27:37,520
the top of the atmosphere

2259
01:27:41,679 --> 01:27:45,350
telemetry will have stopped

2260
01:27:49,510 --> 01:27:47,030
telecom is confirming that the

2261
01:27:52,390 --> 01:27:49,520
spacecraft has switched to broadcasting

2262
01:27:53,990 --> 01:27:52,400
tones these tones are received directly

2263
01:27:56,550 --> 01:27:54,000

from perseverance but have

2264
01:27:57,750 --> 01:27:56,560
very limited information content we

2265
01:28:01,910 --> 01:27:57,760
won't receive

2266
01:28:05,510 --> 01:28:03,830
nine ten minutes from now once the mars

2267
01:28:07,110 --> 01:28:05,520
reconnaissance orbiter

2268
01:28:09,510 --> 01:28:07,120
starts relaying information from

2269
01:28:10,950 --> 01:28:09,520
perseverance we are under a minute from

2270
01:28:12,830 --> 01:28:10,960
cruise stage separation

2271
01:28:15,189 --> 01:28:12,840
about ten and a half minutes from entry

2272
01:28:17,189 --> 01:28:15,199
interface

2273
01:28:19,030 --> 01:28:17,199
it's getting exciting i have to admit i

2274
01:28:21,110 --> 01:28:19,040
am quite anxious

2275
01:28:22,070 --> 01:28:21,120
uh but very hopeful this machine is

2276
01:28:25,030 --> 01:28:22,080
going to do what we asked

2277
01:28:25,910 --> 01:28:25,040
you're seeing the heartbeat tones okay

2278
01:28:27,350 --> 01:28:25,920
that means that we

2279
01:28:28,709 --> 01:28:27,360
there's no more ones and zeros coming

2280
01:28:39,189 --> 01:28:28,719
it's just the vehicle telling us it's

2281
01:28:42,629 --> 01:28:41,110
they're continuing to receive tones from

2282
01:29:04,229 --> 01:28:42,639
perseverance coming

2283
01:29:08,830 --> 01:29:05,830
we have indication that cruise stage

2284
01:29:13,030 --> 01:29:08,840
separation has been confirmed by the

2285
01:29:17,030 --> 01:29:15,189
we're off on a good start in about one

2286
01:29:18,550 --> 01:29:17,040
minute press advances landing software

2287
01:29:20,229 --> 01:29:18,560
will wake up and begin the final

2288
01:29:22,550 --> 01:29:20,239

preparations for entry

2289
01:29:23,990 --> 01:29:22,560
the first action it will do is to fire

2290
01:29:26,550 --> 01:29:24,000
warm-up pulses with

2291
01:29:28,470 --> 01:29:26,560
entry thrusters these pulses ensure that

2292
01:29:30,629 --> 01:29:28,480
the spacecraft gets the thrust that it

2293
01:29:36,830 --> 01:29:30,639
wants during entry interface

2294
01:29:40,870 --> 01:29:38,870
interface

2295
01:29:42,390 --> 01:29:40,880
okay so now the vehicle's on its own

2296
01:29:43,350 --> 01:29:42,400
it's gonna it's turning itself into the

2297
01:29:45,910 --> 01:29:43,360
direction of

2298
01:29:46,470 --> 01:29:45,920
facing the heat shield toward mars and

2299
01:29:51,270 --> 01:29:46,480
uh

2300
01:29:52,629 --> 01:29:51,280
top of the atmosphere we're not far away

2301
01:30:00,229 --> 01:29:52,639
this is going to go very quickly from

2302
01:30:05,030 --> 01:30:02,550
i have confirmation that we got shadowed

2303
01:30:07,750 --> 01:30:05,040
by the cruise stage

2304
01:30:10,790 --> 01:30:07,760
as it uh passed through our beam to the

2305
01:30:15,510 --> 01:30:13,030
telecom indicated actually that we could

2306
01:30:16,790 --> 01:30:15,520
see a signal that the crew stage went

2307
01:30:19,110 --> 01:30:16,800
between

2308
01:30:21,189 --> 01:30:19,120
the perseverance engine capsule and

2309
01:30:24,629 --> 01:30:21,199
earth so we saw a little blip

2310
01:30:28,149 --> 01:30:24,639
uh the data stream indicating the

2311
01:30:31,830 --> 01:30:30,149
we have confirmation that the vehicle

2312
01:30:33,350 --> 01:30:31,840
has started warming up those entry

2313
01:30:42,950 --> 01:30:33,360

thrusters

2314
01:30:46,390 --> 01:30:45,590
at this point the spacecraft is trying

2315
01:30:49,189 --> 01:30:46,400
to stop

2316
01:30:51,030 --> 01:30:49,199
its spin from the cruise two revolutions

2317
01:30:52,870 --> 01:30:51,040
per minute down to zero

2318
01:30:54,229 --> 01:30:52,880
and then we'll turn to its desired

2319
01:30:57,990 --> 01:30:54,239
orientation from

2320
01:30:59,750 --> 01:30:58,000
entry it will separate the two balance

2321
01:31:00,629 --> 01:30:59,760
maps that have kept it balanced during

2322
01:31:02,149 --> 01:31:00,639
all of cruise

2323
01:31:03,830 --> 01:31:02,159
this will allow the entry capsule to

2324
01:31:05,910 --> 01:31:03,840
have lift when

2325
01:31:07,110 --> 01:31:05,920
it enters the atmosphere we have

2326
01:31:10,229 --> 01:31:07,120
competition that

2327
01:31:13,189 --> 01:31:10,239
has turned to the desire entry

2328
01:31:18,790 --> 01:31:13,199
attitude we are about seven and a half

2329
01:31:21,990 --> 01:31:20,870
okay the vehicle is pointed in the right

2330
01:31:24,310 --> 01:31:22,000
direction

2331
01:31:25,510 --> 01:31:24,320
thrusters are warmed up and doing their

2332
01:31:28,870 --> 01:31:25,520
job

2333
01:31:30,550 --> 01:31:28,880
and now now if we've spun down from

2334
01:31:32,229 --> 01:31:30,560
the two revolutions per minute that the

2335
01:31:34,709 --> 01:31:32,239
vehicle had the whole way to on the way

2336
01:31:36,709 --> 01:31:34,719
to mars is a spin stabilized spacecraft

2337
01:31:37,990 --> 01:31:36,719
and then from here on out it's going to

2338
01:31:39,910 --> 01:31:38,000

just be a bullet

2339
01:31:41,430 --> 01:31:39,920
and it's going to control its orient

2340
01:31:43,750 --> 01:31:41,440
orientation and attitude

2341
01:31:45,430 --> 01:31:43,760
via rockets on the back of points

2342
01:31:48,709 --> 01:31:45,440
carrier lock

2343
01:31:51,430 --> 01:31:48,719
sorry the dte from uh

2344
01:31:53,430 --> 01:31:51,440
radio science from uh green bank reports

2345
01:32:00,070 --> 01:31:53,440
carry a lot

2346
01:32:03,910 --> 01:32:03,510
flight level one we are continuing to

2347
01:32:05,830 --> 01:32:03,920
wait

2348
01:32:08,229 --> 01:32:05,840
for entry interface for about six

2349
01:32:09,590 --> 01:32:08,239
minutes and 45 seconds from entry

2350
01:32:12,390 --> 01:32:09,600
interface

2351
01:32:13,430 --> 01:32:12,400
we have confirmation from greenback that

2352
01:32:16,709 --> 01:32:13,440
they are receiving

2353
01:32:20,629 --> 01:32:16,719
direct earth telemetry via that

2354
01:32:21,590 --> 01:32:20,639
path the spacecraft perseverance is

2355
01:32:24,229 --> 01:32:21,600
currently

2356
01:32:26,870 --> 01:32:24,239
transmitting heartbeat tones these tones

2357
01:32:29,189 --> 01:32:26,880
indicate that perseverance is operating

2358
01:32:32,229 --> 01:32:29,199
normally and has nothing significant to

2359
01:32:35,430 --> 01:32:35,030
this is as expected we're currently just

2360
01:32:44,870 --> 01:32:35,440
over

2361
01:32:44,880 --> 01:32:53,350
okay and now we wait

2362
01:32:56,390 --> 01:32:54,629
as soon as we get to the top of the

2363
01:32:57,990 --> 01:32:56,400

atmosphere the atm

2364
01:33:00,629 --> 01:32:58,000
will be very quickly which is the entry

2365
01:33:02,470 --> 01:33:00,639
point it won't be very long before

2366
01:33:04,149 --> 01:33:02,480
the the the atmosphere will start

2367
01:33:05,270 --> 01:33:04,159
getting thicker and thicker it's going

2368
01:33:07,750 --> 01:33:05,280
very quickly at

2369
01:33:09,510 --> 01:33:07,760
a fairly steep angle of 15 degrees into

2370
01:33:12,390 --> 01:33:09,520
the atmosphere as it starts to slow down

2371
01:33:14,470 --> 01:33:12,400
just under about five and a half minutes

2372
01:33:17,350 --> 01:33:14,480
from entry interface

2373
01:33:18,310 --> 01:33:17,360
we're still receiving heartbeat tones we

2374
01:33:19,830 --> 01:33:18,320
expect to continue

2375
01:33:22,390 --> 01:33:19,840
receiving heartbeat tones until about

2376
01:33:23,189 --> 01:33:22,400
five minutes after entry at that time

2377
01:33:24,790 --> 01:33:23,199
perseverance

2378
01:33:26,790 --> 01:33:24,800
will be no longer in view of our

2379
01:33:29,830 --> 01:33:26,800
antennas here on earth

2380
01:33:31,110 --> 01:33:29,840
about 90 seconds prior to entry the mars

2381
01:33:33,110 --> 01:33:31,120
reconnaissance orbiter

2382
01:33:34,470 --> 01:33:33,120
should begin receiving telemetry from

2383
01:33:36,550 --> 01:33:34,480
perseverance

2384
01:33:37,750 --> 01:33:36,560
and streaming it to earth in near real

2385
01:33:41,030 --> 01:33:37,760
time

2386
01:33:43,270 --> 01:33:41,040
there are a few expected short outages

2387
01:33:45,430 --> 01:33:43,280
such as when we have a plasma back out

2388
01:33:47,750 --> 01:33:45,440

or when we enter the peak heating

2389
01:33:50,149 --> 01:33:47,760
phase aside from these outages caused by

2390
01:33:52,390 --> 01:33:50,159
the plasma blackout antenna switching or

2391
01:33:54,629 --> 01:33:52,400
high dynamic events spacecraft events we

2392
01:33:55,590 --> 01:33:54,639
should have telemetry until about 90

2393
01:33:59,910 --> 01:33:55,600
seconds

2394
01:34:02,790 --> 01:33:59,920
after landing a plasma blackout

2395
01:34:03,990 --> 01:34:02,800
is when the signal from perseverance

2396
01:34:06,629 --> 01:34:04,000
isn't strong enough to make it

2397
01:34:08,470 --> 01:34:06,639
through the superheated super fast air

2398
01:34:09,830 --> 01:34:08,480
flowing around the spacecraft

2399
01:34:11,430 --> 01:34:09,840
all the way down to earth once the

2400
01:34:13,270 --> 01:34:11,440
temperature drops below that peak

2401
01:34:14,629 --> 01:34:13,280
heating we do reacquire the signal from

2402
01:34:16,310 --> 01:34:14,639
perseverance

2403
01:34:19,030 --> 01:34:16,320
we are currently about four and a half

2404
01:34:20,709 --> 01:34:19,040
minutes from entry interface

2405
01:34:22,550 --> 01:34:20,719
perseverance continues to report

2406
01:34:25,910 --> 01:34:22,560
heartbeat tones indicating everything

2407
01:34:27,750 --> 01:34:25,920
is nominal okay

2408
01:34:29,910 --> 01:34:27,760
what we wait what we're looking for now

2409
01:34:30,950 --> 01:34:29,920
is where mars reconstance orbiter should

2410
01:34:33,430 --> 01:34:30,960
be in view

2411
01:34:35,110 --> 01:34:33,440
soon of our vehicle and be able to

2412
01:34:36,229 --> 01:34:35,120
listen to ones and zeros coming from a

2413
01:34:37,830 --> 01:34:36,239

separate radio

2414
01:34:40,229 --> 01:34:37,840
that's really designed to talk between

2415
01:34:41,750 --> 01:34:40,239
spacecraft camera reports the electro

2416
01:34:43,030 --> 01:34:41,760
radio is powered on ready to receive

2417
01:34:46,470 --> 01:34:43,040
signals from the lander

2418
01:34:48,390 --> 01:34:46,480
okay mro is ready and less and able

2419
01:34:49,669 --> 01:34:48,400
and waiting for the to hear from our

2420
01:34:52,229 --> 01:34:49,679
rover mars reconnaissance

2421
01:34:54,390 --> 01:34:52,239
orbiter has reported that it's ready to

2422
01:34:57,430 --> 01:34:54,400
receive the signals from perseverance

2423
01:35:00,070 --> 01:34:57,440
it should be in a few minutes here we're

2424
01:35:05,910 --> 01:35:00,080
just light local ones from entry

2425
01:35:08,950 --> 01:35:07,669
we don't need these ones and zeros as

2426
01:35:11,669 --> 01:35:08,960
swati said

2427
01:35:13,510 --> 01:35:11,679
but to land safely but we really need it

2428
01:35:15,109 --> 01:35:13,520
for our own

2429
01:35:17,590 --> 01:35:15,119
health and well-being today to keep our

2430
01:35:20,149 --> 01:35:17,600
nerves in control around this time

2431
01:35:22,229 --> 01:35:20,159
a second spacecraft maven should begin

2432
01:35:23,910 --> 01:35:22,239
picking up telemetry from perseverance

2433
01:35:25,910 --> 01:35:23,920
and will continue to record that

2434
01:35:26,870 --> 01:35:25,920
telemetry until several minutes post

2435
01:35:29,669 --> 01:35:26,880
landing

2436
01:35:30,550 --> 01:35:29,679
we won't get that data for several hours

2437
01:35:32,709 --> 01:35:30,560
after landing

2438
01:35:34,070 --> 01:35:32,719

as it's being recorded and then will be

2439
01:35:37,030 --> 01:35:34,080
forwarded to earth

2440
01:35:38,390 --> 01:35:37,040
later we are continuing to receive

2441
01:35:40,229 --> 01:35:38,400
heartbeat tones

2442
01:35:41,669 --> 01:35:40,239
indicating that everything is nominal

2443
01:35:43,350 --> 01:35:41,679
we're currently at

2444
01:35:46,149 --> 01:35:43,360
about three minutes until entry

2445
01:35:46,159 --> 01:35:51,430
okay

2446
01:35:55,189 --> 01:35:53,030
very soon we'll be getting ones and

2447
01:36:06,070 --> 01:35:55,199
zeroes i hope from our radio on the

2448
01:36:09,830 --> 01:36:07,990
the entry interface is nothing more than

2449
01:36:11,750 --> 01:36:09,840
just an arbitrary place in the sky that

2450
01:36:13,669 --> 01:36:11,760
we've defined to be above the atmosphere

2451
01:36:15,590 --> 01:36:13,679
but but from that point on uh there's

2452
01:36:17,350 --> 01:36:15,600
definitely a

2453
01:36:19,030 --> 01:36:17,360
atmosphere and above it there isn't

2454
01:36:19,830 --> 01:36:19,040
there are two minutes from entry

2455
01:36:22,950 --> 01:36:19,840
interface

2456
01:36:25,510 --> 01:36:22,960
presidents to transmit

2457
01:36:29,910 --> 01:36:25,520
heartbeat tones indicating everything is

2458
01:36:32,950 --> 01:36:31,430
so the tones can tell us whether

2459
01:36:35,270 --> 01:36:32,960
something is bad or not is happening so

2460
01:36:37,430 --> 01:36:35,280
so far the heartbeat is is doing well

2461
01:36:40,149 --> 01:36:37,440
so the vehicle thinks it's help it's in

2462
01:36:57,510 --> 01:36:40,159
good shape to land

2463
01:37:00,550 --> 01:36:59,430

we're just under two minutes from entry

2464
01:37:02,629 --> 01:37:00,560
interface as

2465
01:37:03,910 --> 01:37:02,639
it gets closer to mars preservance is

2466
01:37:06,629 --> 01:37:03,920
actually being pulled in

2467
01:37:08,229 --> 01:37:06,639
by gravity and accelerating by the time

2468
01:37:09,270 --> 01:37:08,239
perseverance reaches entry interface

2469
01:37:11,990 --> 01:37:09,280
point

2470
01:37:13,910 --> 01:37:12,000
it should be going just under 5.4

2471
01:37:17,430 --> 01:37:13,920
kilometers per second

2472
01:37:18,070 --> 01:37:17,440
we're at about 90 seconds from entry

2473
01:37:20,229 --> 01:37:18,080
interface

2474
01:37:21,669 --> 01:37:20,239
and standing by for mars reconnaissance

2475
01:37:49,430 --> 01:37:21,679
orbiter to pick up

2476
01:37:49,440 --> 01:38:08,229
we are one minute from entry interface

2477
01:38:13,990 --> 01:38:11,590
mros are in receive mode

2478
01:38:14,709 --> 01:38:14,000
we have confirmation that the confidence

2479
01:38:17,910 --> 01:38:14,719
orbiter is

2480
01:38:19,830 --> 01:38:17,920
now relating data from perseverance

2481
01:38:21,030 --> 01:38:19,840
we're about 30 seconds from entry

2482
01:38:23,030 --> 01:38:21,040
interface

2483
01:38:25,590 --> 01:38:23,040
procurement is going about 5.2

2484
01:38:26,709 --> 01:38:25,600
kilometers per second and is about 190

2485
01:38:29,270 --> 01:38:26,719
kilometers

2486
01:38:37,590 --> 01:38:29,280
altitude above the surface of mars to

2487
01:38:44,310 --> 01:38:41,910
about seconds from entry interface

2488
01:38:45,430 --> 01:38:44,320

5.3 kilometers per second and an

2489
01:39:04,790 --> 01:38:45,440
altitude of

2490
01:39:10,550 --> 01:39:07,910
we have confirmation of entry interface

2491
01:39:11,669 --> 01:39:10,560
presidents is currently going 5.3

2492
01:39:14,950 --> 01:39:11,679
kilometers per second

2493
01:39:24,390 --> 01:39:14,960
at an altitude of about 120 kilometers

2494
01:39:31,990 --> 01:39:28,390
the fifth is now waiting until it begins

2495
01:39:34,390 --> 01:39:32,000
feeling the atmosphere slow it down

2496
01:39:35,750 --> 01:39:34,400
once there is enough atmosphere it will

2497
01:39:43,669 --> 01:39:35,760
start controlling its

2498
01:39:49,189 --> 01:39:46,310
navigation is also confirming that we

2499
01:39:52,310 --> 01:39:49,199
can see a little bit of that slowdown

2500
01:39:55,590 --> 01:39:52,320
of the atmosphere on

2501
01:39:59,510 --> 01:39:55,600
the perseverance entry capsule

2502
01:40:01,350 --> 01:39:59,520
our current velocity is about 5.36

2503
01:40:03,109 --> 01:40:01,360
kilometers per second and an altitude of

2504
01:40:05,910 --> 01:40:03,119
about 67

2505
01:40:07,830 --> 01:40:05,920
kilometers from the surface we are

2506
01:40:18,470 --> 01:40:07,840
probably seeing mro plasma blackout at

2507
01:40:27,830 --> 01:40:19,990
the vehicle should be doing its turns

2508
01:40:30,870 --> 01:40:29,990
we have indications that perseverance is

2509
01:40:32,870 --> 01:40:30,880
now

2510
01:40:34,470 --> 01:40:32,880
performing bank reversals in the

2511
01:40:37,669 --> 01:40:34,480
atmosphere these

2512
01:40:41,590 --> 01:40:37,679
are the steps in order to control its

2513
01:40:43,430 --> 01:40:41,600

distance to the landing target

2514
01:40:45,270 --> 01:40:43,440
perseverance has just passed through the

2515
01:40:47,830 --> 01:40:45,280
point of maximum deceleration

2516
01:40:49,109 --> 01:40:47,840
and has indicated that it felt

2517
01:40:52,629 --> 01:40:49,119
approximately

2518
01:40:55,910 --> 01:40:52,639
10 earth g's of deceleration

2519
01:41:03,669 --> 01:41:01,350
yes yes yes we saw a small outage

2520
01:41:05,109 --> 01:41:03,679
of the uhf telemetry from mars

2521
01:41:07,510 --> 01:41:05,119
reconnaissance orbiter

2522
01:41:08,229 --> 01:41:07,520
during that peak heating phase likely

2523
01:41:10,629 --> 01:41:08,239
caused

2524
01:41:12,310 --> 01:41:10,639
by the plasma blackout perseverance is

2525
01:41:13,350 --> 01:41:12,320
still continuing to perform bank

2526
01:41:16,310 --> 01:41:13,360
reversals

2527
01:41:32,950 --> 01:41:16,320
in the atmosphere to control its

2528
01:41:36,870 --> 01:41:35,109
perseverance is going about one

2529
01:41:39,750 --> 01:41:36,880
kilometer per second

2530
01:41:41,910 --> 01:41:39,760
at an altitude of about 16 kilometers

2531
01:41:44,629 --> 01:41:41,920
from the surface of mars

2532
01:41:45,030 --> 01:41:44,639
we have entered heading alignment which

2533
01:41:46,950 --> 01:41:45,040
means

2534
01:41:48,070 --> 01:41:46,960
perseverance is no longer trying to

2535
01:41:51,510 --> 01:41:48,080
control the distance

2536
01:41:53,109 --> 01:41:51,520
to mars but in to the target on mars but

2537
01:42:12,830 --> 01:41:53,119
instead is flying

2538
01:42:12,840 --> 01:42:25,910

parachute

2539
01:42:32,310 --> 01:42:30,629
her current velocity is about 550 meters

2540
01:42:33,270 --> 01:42:32,320
per second at an altitude of about 15

2541
01:42:39,750 --> 01:42:33,280
kilometers

2542
01:42:39,760 --> 01:42:44,149
amaro is reporting good telemetry lock

2543
01:42:48,629 --> 01:42:46,870
we are coming upon to straighten up we

2544
01:42:50,070 --> 01:42:48,639
are starting the straighten up and fly

2545
01:42:51,830 --> 01:42:50,080
right maneuver

2546
01:42:53,669 --> 01:42:51,840
where the spacecraft will jettison the

2547
01:42:55,750 --> 01:42:53,679
entry balance masses

2548
01:42:57,590 --> 01:42:55,760
in preparation for parachute deploy and

2549
01:43:02,709 --> 01:42:57,600
to roll over to give the radar a better

2550
01:43:06,629 --> 01:43:04,870
the navigation has confirmed that the

2551
01:43:08,790 --> 01:43:06,639
parachute has deployed and we are seeing

2552
01:43:10,870 --> 01:43:08,800
significant deceleration

2553
01:43:12,950 --> 01:43:10,880
in the velocity our current velocity is

2554
01:43:14,950 --> 01:43:12,960
450 meters per second

2555
01:43:26,629 --> 01:43:14,960
at an altitude of about 12 kilometers

2556
01:43:30,390 --> 01:43:29,030
first advance has now slowed to subsonic

2557
01:43:31,350 --> 01:43:30,400
speeds and the heat shield has been

2558
01:43:33,590 --> 01:43:31,360
separated

2559
01:43:35,830 --> 01:43:33,600
this allows both the radar and the

2560
01:43:36,470 --> 01:43:35,840
cameras to get their first look at the

2561
01:43:39,109 --> 01:43:36,480
surface

2562
01:43:40,950 --> 01:43:39,119
current velocity is 145 meters per

2563
01:43:43,030 --> 01:43:40,960

second and an altitude of about

2564
01:44:03,830 --> 01:43:43,040
10 km nine and a half kilometers above

2565
01:44:03,840 --> 01:44:08,390
yes yes yes

2566
01:44:11,430 --> 01:44:10,709
now has radar lock on the ground current

2567
01:44:14,470 --> 01:44:11,440
velocity

2568
01:44:20,390 --> 01:44:14,480
is about 100 meters per second 6.6

2569
01:44:22,310 --> 01:44:20,400
kilometers of the surface

2570
01:44:23,430 --> 01:44:22,320
perseverance is continuing to descend on

2571
01:44:26,629 --> 01:44:23,440
the parachute

2572
01:44:28,550 --> 01:44:26,639
we are coming up on the initialization

2573
01:44:30,390 --> 01:44:28,560
of terrain relative navigation

2574
01:44:32,709 --> 01:44:30,400
and subsequently the priming of the

2575
01:44:35,030 --> 01:44:32,719
landing engines our current velocity is

2576
01:44:43,109 --> 01:44:35,040
about 90 meters per second at an

2577
01:44:46,149 --> 01:44:44,310
we have confirmation that the land

2578
01:44:47,030 --> 01:44:46,159
division system has produced a valid

2579
01:44:52,550 --> 01:44:47,040
solution

2580
01:44:52,560 --> 01:45:01,030
we have timing of the landing engines

2581
01:45:06,950 --> 01:45:03,990
current velocity is 83 meters per second

2582
01:45:07,750 --> 01:45:06,960
at about 2.6 kilometers from the surface

2583
01:45:09,270 --> 01:45:07,760
mars

2584
01:45:10,790 --> 01:45:09,280
we have confirmation that the back shell

2585
01:45:12,470 --> 01:45:10,800
has separated

2586
01:45:14,950 --> 01:45:12,480
we are currently performing the divert

2587
01:45:16,870 --> 01:45:14,960
maneuver current velocity is about 75

2588
01:45:19,030 --> 01:45:16,880

meters per second at an altitude

2589
01:45:20,310 --> 01:45:19,040
of about a kilometer off the surface of

2590
01:45:23,350 --> 01:45:20,320
mars

2591
01:45:25,430 --> 01:45:23,360
tier end safety bravo

2592
01:45:26,870 --> 01:45:25,440
we have completed our terrain relative

2593
01:45:29,270 --> 01:45:26,880
navigation

2594
01:45:31,750 --> 01:45:29,280
current speed is about 30 meters per

2595
01:45:41,910 --> 01:45:31,760
second altitude of about 300 meters

2596
01:45:45,669 --> 01:45:44,229
we have started our constant velocity

2597
01:45:48,390 --> 01:45:45,679
accordion which means we are

2598
01:45:50,390 --> 01:45:48,400
conducting the sky crane about to

2599
01:45:53,830 --> 01:45:50,400
conduct the cycling maneuver

2600
01:45:56,870 --> 01:45:53,840
we've lost direct to earth tones

2601
01:46:00,629 --> 01:45:56,880
as expected as expected

2602
01:46:00,639 --> 01:46:11,189
about 20 meters off the surface

2603
01:46:11,199 --> 01:46:17,430
we're getting signals from mro

2604
01:46:17,440 --> 01:46:22,070
uhf is good

2605
01:46:22,080 --> 01:46:25,350
touchdown

2606
01:46:31,580 --> 01:46:28,149
on the confirmed of mars ready to begin

2607
01:46:37,669 --> 01:46:31,590
seeking the sands of past life

2608
01:46:41,590 --> 01:46:39,270
at this point the descending stage has

2609
01:46:45,350 --> 01:46:41,600
flown away to safe distance

2610
01:46:52,830 --> 01:46:45,360
perseverance is continuing to transmit

2611
01:46:52,840 --> 01:46:58,870
earth

2612
01:47:08,790 --> 01:47:01,830
[Applause]

2613
01:47:14,629 --> 01:47:08,800

oh my god oh

2614
01:47:21,669 --> 01:47:18,629
all right all stations uh we got it

2615
01:47:25,030 --> 01:47:21,679
we're gonna wait for the images wow

2616
01:47:26,070 --> 01:47:25,040
this is so exciting the team is beside

2617
01:47:28,470 --> 01:47:26,080
themselves it's

2618
01:47:46,310 --> 01:47:28,480
it's so surreal stay tuned we might get

2619
01:47:46,320 --> 01:47:52,229
so much has been riding on this

2620
01:48:04,310 --> 01:47:55,350
we just heard the news that perseverance

2621
01:48:07,669 --> 01:48:04,320
is alive on the surface of mars

2622
01:48:18,950 --> 01:48:07,679
we have seen the completion of edl 3000

2623
01:48:20,550 --> 01:48:18,960
copy activity that is as expected

2624
01:48:36,310 --> 01:48:20,560
amarillo is still seeing a strong signal

2625
01:48:39,510 --> 01:48:37,750
we have just heard the news that

2626
01:48:42,390 --> 01:48:39,520
perseverance is alive

2627
01:48:43,210 --> 01:48:42,400
on the surface of mars congratulations

2628
01:48:45,510 --> 01:48:43,220
to the mission

2629
01:48:47,030 --> 01:48:45,520
[Applause]

2630
01:48:50,550 --> 01:48:47,040
looks like we have some more news in it

2631
01:48:55,910 --> 01:48:50,560
looks like we're getting the first image

2632
01:49:02,149 --> 01:48:59,510
flight this is ol3 i have

2633
01:49:03,270 --> 01:49:02,159
the target point on the map when you are

2634
01:49:26,870 --> 01:49:03,280
ready

2635
01:49:39,430 --> 01:49:29,589
flight i'll be uh moving in showing you

2636
01:49:42,629 --> 01:49:41,589
the team has just put the first image

2637
01:49:45,189 --> 01:49:42,639
firm perseverance

2638
01:49:46,870 --> 01:49:45,199

on the surface of mars now it comes from

2639
01:49:49,750 --> 01:49:46,880
the engineering cameras

2640
01:49:51,830 --> 01:49:49,760
known as the hazard camera this camera

2641
01:49:54,149 --> 01:49:51,840
is mainly used to help the rover drive

2642
01:49:55,990 --> 01:49:54,159
safely around mars and we will get

2643
01:50:06,310 --> 01:49:56,000
higher resolution photos later

2644
01:50:06,320 --> 01:50:26,149
nice this is amazing

2645
01:50:26,159 --> 01:50:41,430
stand by for steve

2646
01:51:01,750 --> 01:50:44,870
you did you did it

2647
01:51:11,510 --> 01:51:04,830
[Music]

2648
01:51:15,109 --> 01:51:14,550
we just got our second image in our

2649
01:51:18,470 --> 01:51:15,119
second

2650
01:51:20,229 --> 01:51:18,480
image is in

2651
01:51:21,910 --> 01:51:20,239
okay this these these we have a camera

2652
01:51:24,950 --> 01:51:21,920
in the front and out rear the

2653
01:51:26,070 --> 01:51:24,960
the spacecraft uh it's uh it's it's

2654
01:51:27,350 --> 01:51:26,080
they're near the ground so these are

2655
01:51:28,070 --> 01:51:27,360
pretty close you can see the wheels

2656
01:51:30,470 --> 01:51:28,080
there

2657
01:51:31,430 --> 01:51:30,480
uh and and and they're a little dirty

2658
01:51:34,070 --> 01:51:31,440
because you've got

2659
01:51:34,470 --> 01:51:34,080
uh glass covers over these these cameras

2660
01:51:36,550 --> 01:51:34,480
but

2661
01:51:37,990 --> 01:51:36,560
we took these seconds after landing so

2662
01:51:39,109 --> 01:51:38,000
so there's still dust in the air from

2663
01:51:42,470 --> 01:51:39,119

our landing event

2664
01:51:44,310 --> 01:51:42,480
uh so this is this is happening um uh

2665
01:51:45,510 --> 01:51:44,320
you know this happened just seconds ago

2666
01:51:47,980 --> 01:51:45,520
just arrived

2667
01:51:49,189 --> 01:51:47,990
and this is really amazing

2668
01:51:51,350 --> 01:51:49,199
[Applause]

2669
01:51:52,870 --> 01:51:51,360
and uh we even know where we landed this

2670
01:51:53,669 --> 01:51:52,880
is the most amazing thing the vehicle

2671
01:51:55,910 --> 01:51:53,679
has told us where

2672
01:51:57,270 --> 01:51:55,920
where it's landed because figured it out

2673
01:52:00,550 --> 01:51:57,280
you know this is a sign

2674
01:52:01,430 --> 01:52:00,560
nasa works nasa works and we put our

2675
01:52:02,870 --> 01:52:01,440
arms together

2676
01:52:05,030 --> 01:52:02,880
and our hands together and our brains

2677
01:52:06,870 --> 01:52:05,040
together we can succeed

2678
01:52:08,390 --> 01:52:06,880
this is what nasa does this is what we

2679
01:52:10,470 --> 01:52:08,400
can do as a country

2680
01:52:11,510 --> 01:52:10,480
on all of the problems we we have we

2681
01:52:13,510 --> 01:52:11,520
need to work together

2682
01:52:25,270 --> 01:52:13,520
to do these kinds of things and make

2683
01:52:30,950 --> 01:52:28,310
joining us now is the acting

2684
01:52:31,510 --> 01:52:30,960
administrator of nasa steve jurisic

2685
01:52:34,550 --> 01:52:31,520
steve

2686
01:52:37,830 --> 01:52:34,560
welcome and congratulations

2687
01:52:40,470 --> 01:52:37,840
hey thank you what an amazing day

2688
01:52:41,669 --> 01:52:40,480

how does it feel to have another rover

2689
01:52:44,790 --> 01:52:41,679
on mars

2690
01:52:45,910 --> 01:52:44,800
uh it's amazing um uh to have

2691
01:52:49,109 --> 01:52:45,920
perseverance join

2692
01:52:51,270 --> 01:52:49,119
curiosity on mars and what

2693
01:52:53,430 --> 01:52:51,280
what a just a credit to the team i mean

2694
01:52:57,430 --> 01:52:53,440
just what an amazing team

2695
01:52:59,189 --> 01:52:57,440
um to work through all the adversity

2696
01:53:01,350 --> 01:52:59,199
that goes and all the challenges that go

2697
01:53:04,390 --> 01:53:01,360
with landing a rover on mars

2698
01:53:07,430 --> 01:53:04,400
plus the challenges of covid and

2699
01:53:10,229 --> 01:53:07,440
um and just an amazing accomplishment

2700
01:53:12,070 --> 01:53:10,239
and what does this mean for nasa and its

2701
01:53:14,790 --> 01:53:12,080
future plans

2702
01:53:15,270 --> 01:53:14,800
so for robotic exploration no every time

2703
01:53:17,189 --> 01:53:15,280
we

2704
01:53:18,470 --> 01:53:17,199
um execute a mission with new

2705
01:53:20,790 --> 01:53:18,480
instruments we

2706
01:53:22,070 --> 01:53:20,800
discover new things and things we never

2707
01:53:24,390 --> 01:53:22,080
thought we would discover

2708
01:53:25,830 --> 01:53:24,400
so that's that always informs our future

2709
01:53:29,109 --> 01:53:25,840
robotic missions

2710
01:53:32,070 --> 01:53:29,119
both landers rovers and orbiters

2711
01:53:33,990 --> 01:53:32,080
this mission also has technology on it

2712
01:53:35,990 --> 01:53:34,000
one of the cool things is the ingenuity

2713
01:53:38,550 --> 01:53:36,000

helicopter

2714
01:53:39,990 --> 01:53:38,560
it's an experiment on this mission but

2715
01:53:42,390 --> 01:53:40,000
if it's successful we can use

2716
01:53:44,310 --> 01:53:42,400
it as an observation science observation

2717
01:53:47,350 --> 01:53:44,320
platform by putting instruments on it

2718
01:53:50,470 --> 01:53:47,360
and also use it as a scout um for

2719
01:53:51,030 --> 01:53:50,480
future rover missions and uh and then

2720
01:53:54,229 --> 01:53:51,040
just the

2721
01:53:57,270 --> 01:53:54,239
entry sentence landing um capability

2722
01:53:59,750 --> 01:53:57,280
it'll allow us to land more and

2723
01:54:01,189 --> 01:53:59,760
more larger more ambitious robots on the

2724
01:54:04,870 --> 01:54:01,199
surface of mars and then

2725
01:54:07,430 --> 01:54:04,880
for human exploration um we have

2726
01:54:07,990 --> 01:54:07,440
the medley mars intercept landing

2727
01:54:09,510 --> 01:54:08,000
instrumentation

2728
01:54:12,070 --> 01:54:09,520
which is going to give us edl

2729
01:54:14,550 --> 01:54:12,080
information we have the mars

2730
01:54:15,669 --> 01:54:14,560
environmental dynamics analyzer it's

2731
01:54:18,149 --> 01:54:15,679
going to give us

2732
01:54:19,589 --> 01:54:18,159
uh properties size and properties of

2733
01:54:20,629 --> 01:54:19,599
dust particles because when

2734
01:54:22,950 --> 01:54:20,639
we send people we're going to have to

2735
01:54:24,709 --> 01:54:22,960
deal with that dust

2736
01:54:26,149 --> 01:54:24,719
and just it's just this is just an

2737
01:54:28,149 --> 01:54:26,159
incredible mission because of the

2738
01:54:30,629 --> 01:54:28,159

science and the technology

2739
01:54:31,910 --> 01:54:30,639
and then caching samples from our sample

2740
01:54:33,990 --> 01:54:31,920
return mission

2741
01:54:35,510 --> 01:54:34,000
that will be a an amazing mission the

2742
01:54:37,990 --> 01:54:35,520
first round trip

2743
01:54:39,990 --> 01:54:38,000
to mars and back and bringing those

2744
01:54:41,109 --> 01:54:40,000
samples cached by perseverance back to

2745
01:54:43,990 --> 01:54:41,119
earth to

2746
01:54:46,390 --> 01:54:44,000
examine with state-of-the-art equipment

2747
01:54:49,510 --> 01:54:46,400
in our laboratories here on earth

2748
01:54:51,830 --> 01:54:49,520
we have so much to look forward to and

2749
01:54:53,109 --> 01:54:51,840
we also have a student question coming

2750
01:54:56,390 --> 01:54:53,119
in from landon

2751
01:54:58,470 --> 01:54:56,400
let's take a look hi

2752
01:54:59,669 --> 01:54:58,480
my name is lyndon applegate i'm in sixth

2753
01:55:02,390 --> 01:54:59,679
grade and i'm

2754
01:55:03,589 --> 01:55:02,400
going to academy for academic excellence

2755
01:55:05,669 --> 01:55:03,599
and my question is

2756
01:55:07,589 --> 01:55:05,679
do you think we could get resources from

2757
01:55:11,350 --> 01:55:07,599
mars to help on future missions

2758
01:55:13,589 --> 01:55:11,360
or even as like a launching point

2759
01:55:14,470 --> 01:55:13,599
great question landon actually we have

2760
01:55:17,910 --> 01:55:14,480
an experiment

2761
01:55:20,629 --> 01:55:17,920
called the mox the mars oxygen in situ

2762
01:55:22,950 --> 01:55:20,639
resource utilization experiment or moxie

2763
01:55:26,149 --> 01:55:22,960

and it's going to demonstrate generating

2764
01:55:29,270 --> 01:55:26,159
oxygen from atmospheric co2

2765
01:55:31,510 --> 01:55:29,280
and that could help generate you know

2766
01:55:32,950 --> 01:55:31,520
generate breathable oxygen and even if

2767
01:55:35,350 --> 01:55:32,960
we can liquefy it

2768
01:55:37,830 --> 01:55:35,360
oxidizer for propulsion systems so

2769
01:55:39,270 --> 01:55:37,840
that's a tech demo on perseverance

2770
01:55:41,270 --> 01:55:39,280
and then we're going to continue to

2771
01:55:45,030 --> 01:55:41,280
characterize the frozen water

2772
01:55:46,950 --> 01:55:45,040
on and below the surface of mars

2773
01:55:49,510 --> 01:55:46,960
and eventually try to figure out how to

2774
01:55:51,030 --> 01:55:49,520
extract that water from the martian soil

2775
01:55:53,030 --> 01:55:51,040
or we call regolith

2776
01:55:55,510 --> 01:55:53,040
and then we can use that for potable

2777
01:55:56,629 --> 01:55:55,520
water and also break it down into oxygen

2778
01:55:58,629 --> 01:55:56,639
and hydrogen

2779
01:56:00,390 --> 01:55:58,639
for rocket fuel so absolutely we're

2780
01:56:02,070 --> 01:56:00,400
going to try to eventually

2781
01:56:05,109 --> 01:56:02,080
figure out how to live off the land to

2782
01:56:06,550 --> 01:56:05,119
support human missions to mars

2783
01:56:09,270 --> 01:56:06,560
thanks for taking the time to talk to us

2784
01:56:12,550 --> 01:56:09,280
today steve thank you

2785
01:56:14,070 --> 01:56:12,560
and now that perseverance has safely

2786
01:56:15,830 --> 01:56:14,080
touched down on mars

2787
01:56:17,189 --> 01:56:15,840
let's learn more about what's in store

2788
01:56:19,990 --> 01:56:17,199

for the rover

2789
01:56:20,950 --> 01:56:20,000
joining us now is surface mission

2790
01:56:24,390 --> 01:56:20,960
manager

2791
01:56:25,830 --> 01:56:24,400
jessica samuels jessica your surface

2792
01:56:29,270 --> 01:56:25,840
operations team has now

2793
01:56:32,550 --> 01:56:29,280
taken over what are they doing now yes

2794
01:56:33,510 --> 01:56:32,560
hi raquel we are so excited here in the

2795
01:56:37,270 --> 01:56:33,520
service

2796
01:56:39,030 --> 01:56:37,280
mission support area uh the team will do

2797
01:56:39,830 --> 01:56:39,040
a handover with the entry descent and

2798
01:56:43,669 --> 01:56:39,840
landing team

2799
01:56:45,990 --> 01:56:43,679
and pass any critical information

2800
01:56:48,310 --> 01:56:46,000
and then this team behind us will be the

2801
01:56:51,030 --> 01:56:48,320
team that does the health and safety

2802
01:56:51,990 --> 01:56:51,040
assessments daily as we progress on this

2803
01:56:54,709 --> 01:56:52,000
mission

2804
01:56:56,070 --> 01:56:54,719
and what do the upcoming weeks look like

2805
01:56:59,350 --> 01:56:56,080
for your team

2806
01:57:01,830 --> 01:56:59,360
so as we enter mars time now

2807
01:57:03,990 --> 01:57:01,840
the commanding team will be working

2808
01:57:07,430 --> 01:57:04,000
overnight while the rover is asleep

2809
01:57:09,510 --> 01:57:07,440
so that we can perform the initial

2810
01:57:11,030 --> 01:57:09,520
checkouts of our key rover functions and

2811
01:57:13,589 --> 01:57:11,040
our science instruments

2812
01:57:15,510 --> 01:57:13,599
and we have to do this all in time for

2813
01:57:18,229 --> 01:57:15,520

the regularly scheduled communication

2814
01:57:19,270 --> 01:57:18,239
pass which happens in the morning and so

2815
01:57:22,149 --> 01:57:19,280
we will be working

2816
01:57:24,390 --> 01:57:22,159
around the clock making sure that

2817
01:57:27,430 --> 01:57:24,400
perseverance is healthy and

2818
01:57:29,669 --> 01:57:27,440
um we will begin this exciting adventure

2819
01:57:30,550 --> 01:57:29,679
and can you tell me what's it like

2820
01:57:33,669 --> 01:57:30,560
living on

2821
01:57:34,870 --> 01:57:33,679
mars time it's uh it's a little bit like

2822
01:57:36,709 --> 01:57:34,880
constantly uh

2823
01:57:37,990 --> 01:57:36,719
you know flying and changing your time

2824
01:57:40,870 --> 01:57:38,000
zone uh the

2825
01:57:42,709 --> 01:57:40,880
rover um you know on earth the rover

2826
01:57:44,629 --> 01:57:42,719
wakes up at the same time every day but

2827
01:57:46,629 --> 01:57:44,639
on earth that's 40 minutes later

2828
01:57:48,870 --> 01:57:46,639
so the team is going to be shifting our

2829
01:57:51,189 --> 01:57:48,880
work schedule by 40 minutes as we come

2830
01:57:54,870 --> 01:57:51,199
into work over the next few weeks

2831
01:57:58,390 --> 01:57:54,880
so it'll be uh it'll be exciting and uh

2832
01:58:00,870 --> 01:57:58,400
and some some late late nights but uh

2833
01:58:03,270 --> 01:58:00,880
but we're also excited and uh we

2834
01:58:04,070 --> 01:58:03,280
can't wait it's a whole new lifestyle

2835
01:58:07,189 --> 01:58:04,080
yes

2836
01:58:11,030 --> 01:58:07,199
we also have a student question for you

2837
01:58:13,030 --> 01:58:11,040
this is sophia's video

2838
01:58:14,709 --> 01:58:13,040

hi my name is sophia lopez and my

2839
01:58:17,109 --> 01:58:14,719
question for nasa is

2840
01:58:17,830 --> 01:58:17,119
how's perseverance gonna survive and

2841
01:58:19,910 --> 01:58:17,840
here's a

2842
01:58:21,430 --> 01:58:19,920
drawing that i made from perseverance

2843
01:58:25,189 --> 01:58:21,440
thinking about earth

2844
01:58:25,990 --> 01:58:25,199
thank you well sophia perseverance

2845
01:58:29,109 --> 01:58:26,000
survives

2846
01:58:29,990 --> 01:58:29,119
um with a power source um that charges

2847
01:58:32,070 --> 01:58:30,000
its batteries

2848
01:58:33,910 --> 01:58:32,080
uh overnight while it sleeps and it

2849
01:58:35,510 --> 01:58:33,920
keeps heaters

2850
01:58:37,669 --> 01:58:35,520
on so that all of our critical

2851
01:58:40,629 --> 01:58:37,679
electronics can stay warm

2852
01:58:42,550 --> 01:58:40,639
as well as our mechanism but it's really

2853
01:58:44,950 --> 01:58:42,560
survived by the team

2854
01:58:45,669 --> 01:58:44,960
that performs the health and safety

2855
01:58:47,589 --> 01:58:45,679
assessments

2856
01:58:48,709 --> 01:58:47,599
every day and communicates with the

2857
01:58:51,510 --> 01:58:48,719
rover

2858
01:58:52,950 --> 01:58:51,520
and make sure that she's she's doing

2859
01:58:55,030 --> 01:58:52,960
okay

2860
01:58:56,870 --> 01:58:55,040
well thanks for your time jessica and

2861
01:59:00,550 --> 01:58:56,880
good luck living on mars time

2862
01:59:01,270 --> 01:59:00,560
thank you should be fun let's head back

2863
01:59:03,669 --> 01:59:01,280

to marina

2864
01:59:04,390 --> 01:59:03,679
as she gives us a sneak peek into the

2865
01:59:09,109 --> 01:59:04,400
future

2866
01:59:13,030 --> 01:59:11,510
thanks so much raquel it's definitely

2867
01:59:15,830 --> 01:59:13,040
bustling behind me

2868
01:59:18,229 --> 01:59:15,840
is not quiet like it was just 20 minutes

2869
01:59:20,550 --> 01:59:18,239
ago and congrats to the whole team

2870
01:59:22,870 --> 01:59:20,560
what an amazing accomplishment mike

2871
01:59:25,350 --> 01:59:22,880
watkins is the director of nasa's

2872
01:59:27,589 --> 01:59:25,360
jet propulsion laboratory he was the

2873
01:59:29,669 --> 01:59:27,599
mission manager during the curiosity

2874
01:59:33,030 --> 01:59:29,679
rover landing on mars

2875
01:59:33,669 --> 01:59:33,040
welcome mike oh thanks glen glad to be

2876
01:59:35,560 --> 01:59:33,679
here

2877
01:59:36,950 --> 01:59:35,570
you can see all my mask markings soon

2878
01:59:38,550 --> 01:59:36,960
[Laughter]

2879
01:59:40,870 --> 01:59:38,560
well you were just celebrating and

2880
01:59:43,109 --> 01:59:40,880
rightly so now you've been around for a

2881
01:59:45,030 --> 01:59:43,119
number of mars landings what makes this

2882
01:59:46,950 --> 01:59:45,040
one special

2883
01:59:48,470 --> 01:59:46,960
well you know two things i mean it's the

2884
01:59:49,350 --> 01:59:48,480
biggest and best rover we've ever sent

2885
01:59:50,870 --> 01:59:49,360
to mars

2886
01:59:52,550 --> 01:59:50,880
um and and it can really you know do

2887
01:59:54,310 --> 01:59:52,560
amazing things in terms of you know its

2888
01:59:55,589 --> 01:59:54,320

own scientific exploration of this

2889
01:59:58,070 --> 01:59:55,599
habitable environment you know at

2890
01:59:59,270 --> 01:59:58,080
jezreel but you know it's also as as

2891
02:00:01,270 --> 01:59:59,280
as you've heard today you know it's the

2892
02:00:02,709 --> 02:00:01,280
first step in march sample return so

2893
02:00:04,629 --> 02:00:02,719
really you know it's it's not only doing

2894
02:00:06,070 --> 02:00:04,639
its own mission it's setting us up for

2895
02:00:07,830 --> 02:00:06,080
a series of missions and to bring those

2896
02:00:09,510 --> 02:00:07,840
samples back and you know a lot of the

2897
02:00:11,030 --> 02:00:09,520
effort to develop the rover

2898
02:00:12,550 --> 02:00:11,040
was specifically designed you know for

2899
02:00:14,310 --> 02:00:12,560
that sampling and caching system it's

2900
02:00:15,270 --> 02:00:14,320
one of the most complex robotic systems

2901
02:00:17,109 --> 02:00:15,280
ever made

2902
02:00:18,790 --> 02:00:17,119
and you know having it down safely means

2903
02:00:20,790 --> 02:00:18,800
mars sample return continues

2904
02:00:22,709 --> 02:00:20,800
right on course and and and we are

2905
02:00:25,430 --> 02:00:22,719
moving forward

2906
02:00:26,709 --> 02:00:25,440
wonderful now jpl has a long history

2907
02:00:28,790 --> 02:00:26,719
with robotic space

2908
02:00:30,790 --> 02:00:28,800
exploration why do you think it's so

2909
02:00:32,950 --> 02:00:30,800
important to continue to push those

2910
02:00:34,310 --> 02:00:32,960
boundaries

2911
02:00:36,310 --> 02:00:34,320
you know there's a lot of reasons i mean

2912
02:00:36,629 --> 02:00:36,320
obviously you know for for places that

2913
02:00:39,109 --> 02:00:36,639

are

2914
02:00:40,470 --> 02:00:39,119
far away like mars and even farther away

2915
02:00:42,310 --> 02:00:40,480
you know like europa

2916
02:00:43,830 --> 02:00:42,320
uh right now robots are the robotic

2917
02:00:45,270 --> 02:00:43,840
expressions the only way we can

2918
02:00:47,189 --> 02:00:45,280
make those scientific discoveries and

2919
02:00:48,870 --> 02:00:47,199
really understand these early

2920
02:00:50,870 --> 02:00:48,880
uh habitable environments in the case of

2921
02:00:52,790 --> 02:00:50,880
europa maybe it's even still habitable

2922
02:00:54,149 --> 02:00:52,800
and you know we're not ready to to go

2923
02:00:55,990 --> 02:00:54,159
there with astronauts yet

2924
02:00:57,510 --> 02:00:56,000
uh but the robots are ready to go there

2925
02:00:59,270 --> 02:00:57,520
and so we always uh you know our

2926
02:01:01,430 --> 02:00:59,280
forerunners and pathfinders

2927
02:01:02,550 --> 02:01:01,440
uh of of of human exploration and we

2928
02:01:05,030 --> 02:01:02,560
start by sending

2929
02:01:06,310 --> 02:01:05,040
you know our eyes and and arms there in

2930
02:01:08,149 --> 02:01:06,320
the form of a robot

2931
02:01:10,470 --> 02:01:08,159
and it is just fantastic to be able to

2932
02:01:11,430 --> 02:01:10,480
do that and to learn from each rover

2933
02:01:13,189 --> 02:01:11,440
learn from the science and the

2934
02:01:14,870 --> 02:01:13,199
engineering and make the next one better

2935
02:01:16,470 --> 02:01:14,880
and make more and more discoveries and

2936
02:01:18,629 --> 02:01:16,480
every time we do one of these missions

2937
02:01:20,709 --> 02:01:18,639
we make fabulous discoveries and uh and

2938
02:01:23,750 --> 02:01:20,719

you know each one is is more exciting

2939
02:01:26,149 --> 02:01:23,760
than the last the future does look

2940
02:01:27,430 --> 02:01:26,159
exciting now as director of jpl

2941
02:01:29,669 --> 02:01:27,440
what would you like to say to those

2942
02:01:31,589 --> 02:01:29,679
teams right now celebrating

2943
02:01:33,430 --> 02:01:31,599
oh you know obviously they they have

2944
02:01:35,350 --> 02:01:33,440
earned it let me tell you i mean they

2945
02:01:36,790 --> 02:01:35,360
uh have worked you know for years and

2946
02:01:37,510 --> 02:01:36,800
years on this mission and then in the

2947
02:01:39,589 --> 02:01:37,520
past year

2948
02:01:40,950 --> 02:01:39,599
of course we had the covid experience

2949
02:01:42,709 --> 02:01:40,960
and and you know i want to thank not

2950
02:01:44,870 --> 02:01:42,719
only the team but also you know all of

2951
02:01:47,189 --> 02:01:44,880
jpl you know a lot of folks had to

2952
02:01:49,430 --> 02:01:47,199
had uh had to pitch in here you know in

2953
02:01:50,149 --> 02:01:49,440
terms of making sure our remote telework

2954
02:01:51,910 --> 02:01:50,159
you know our

2955
02:01:53,510 --> 02:01:51,920
it systems were good enough to to

2956
02:01:55,270 --> 02:01:53,520
support folks working from home

2957
02:01:57,030 --> 02:01:55,280
you know all of the folks looking at at

2958
02:01:58,709 --> 02:01:57,040
ppe and our safe distancing and

2959
02:02:01,270 --> 02:01:58,719
reconfiguring facilities

2960
02:02:01,990 --> 02:02:01,280
uh to make them safe for the employees

2961
02:02:03,910 --> 02:02:02,000
it's just an

2962
02:02:05,430 --> 02:02:03,920
incredible amount of work by the entire

2963
02:02:06,229 --> 02:02:05,440

lab and of course especially by this

2964
02:02:08,070 --> 02:02:06,239
team

2965
02:02:09,750 --> 02:02:08,080
and uh you know and in one sense you

2966
02:02:11,990 --> 02:02:09,760
know the seven minutes of terror

2967
02:02:12,790 --> 02:02:12,000
are very exciting uh but on the other

2968
02:02:14,790 --> 02:02:12,800
hand you know

2969
02:02:16,229 --> 02:02:14,800
the missions just started right we built

2970
02:02:17,350 --> 02:02:16,239
the mission you know not to land but

2971
02:02:19,189 --> 02:02:17,360
actually to drive

2972
02:02:21,669 --> 02:02:19,199
and get the samples and do other uh

2973
02:02:24,470 --> 02:02:21,679
technology um you know demonstrations

2974
02:02:24,870 --> 02:02:24,480
and so you know for much of the team you

2975
02:02:26,470 --> 02:02:24,880
know

2976
02:02:28,149 --> 02:02:26,480
uh this part of the mission's over but

2977
02:02:29,990 --> 02:02:28,159
but for most of the team

2978
02:02:31,270 --> 02:02:30,000
the mission's really just starting and

2979
02:02:33,109 --> 02:02:31,280
so uh you know i think they're very

2980
02:02:34,310 --> 02:02:33,119
excited but uh you know everybody i

2981
02:02:36,390 --> 02:02:34,320
think can take a big

2982
02:02:37,669 --> 02:02:36,400
uh a deep breath and a sigh of relief

2983
02:02:39,109 --> 02:02:37,679
now that we are safely down on the

2984
02:02:41,430 --> 02:02:39,119
surface

2985
02:02:43,589 --> 02:02:41,440
yes that collective sigh of relief and i

2986
02:02:45,750 --> 02:02:43,599
hear a lot of excitement and celebration

2987
02:02:46,790 --> 02:02:45,760
behind me as well so thanks so much for

2988
02:02:48,070 --> 02:02:46,800

joining me mike

2989
02:02:50,390 --> 02:02:48,080
it's my pleasure and thanks to everyone

2990
02:02:50,870 --> 02:02:50,400
for joining us too congrats again to the

2991
02:02:53,669 --> 02:02:50,880
mars

2992
02:02:54,310 --> 02:02:53,679
2020 perseverance team for a successful

2993
02:02:58,390 --> 02:02:54,320
landing

2994
02:03:01,669 --> 02:02:58,400
back to you raquel now there will be a

2995
02:03:03,109 --> 02:03:01,679
flight test coming up for the ingenuity

2996
02:03:05,189 --> 02:03:03,119
mars helicopter

2997
02:03:06,149 --> 02:03:05,199
and if this technology experiment is

2998
02:03:08,070 --> 02:03:06,159
successful

2999
02:03:09,669 --> 02:03:08,080
it would mark the first time we have

3000
02:03:13,830 --> 02:03:09,679
taken a power

3001
02:03:18,149 --> 02:03:16,149
sometimes you have to do something just

3002
02:03:20,149 --> 02:03:18,159
to show that you can do it

3003
02:03:21,270 --> 02:03:20,159
when the wright brothers flew for the

3004
02:03:24,070 --> 02:03:21,280
first time they do

3005
02:03:24,470 --> 02:03:24,080
an experimental aircraft and in the same

3006
02:03:26,229 --> 02:03:24,480
way

3007
02:03:28,550 --> 02:03:26,239
the mars helicopter is designed to show

3008
02:03:29,030 --> 02:03:28,560
that we can fly power and helicopter

3009
02:03:37,350 --> 02:03:29,040
flight

3010
02:03:41,109 --> 02:03:39,830
from day one this was the unwavering

3011
02:03:44,310 --> 02:03:41,119
dream of our team

3012
02:03:46,470 --> 02:03:44,320
to get our helicopter launched to mars

3013
02:03:49,189 --> 02:03:46,480

so that we can get the opportunity to do

3014
02:03:51,910 --> 02:03:49,199
the very first rotograph flight test

3015
02:03:53,350 --> 02:03:51,920
in the actual environment of mars it's

3016
02:03:55,990 --> 02:03:53,360
extremely difficult to

3017
02:03:57,589 --> 02:03:56,000
fly at mars because atmosphere is so

3018
02:03:59,669 --> 02:03:57,599
thin compared to earth

3019
02:04:01,750 --> 02:03:59,679
at mars it's less than one percent so

3020
02:04:04,149 --> 02:04:01,760
the first and foremost challenge is

3021
02:04:04,950 --> 02:04:04,159
to make a vehicle that's light enough to

3022
02:04:07,350 --> 02:04:04,960
be lifted

3023
02:04:09,750 --> 02:04:07,360
and then the second is to generate lift

3024
02:04:10,870 --> 02:04:09,760
the rotor system is to spin very fast

3025
02:04:15,109 --> 02:04:10,880
2000

3026
02:04:17,750 --> 02:04:15,119
2200 2400 2600 we're spinning

3027
02:04:19,669 --> 02:04:17,760
between 2000 and 3000 revolutions per

3028
02:04:22,229 --> 02:04:19,679
minute and it takes a lot of energy

3029
02:04:23,270 --> 02:04:22,239
so is that balance of a very light

3030
02:04:26,229 --> 02:04:23,280
system

3031
02:04:26,709 --> 02:04:26,239
yet having enough energy that's needed

3032
02:04:37,189 --> 02:04:26,719
to

3033
02:04:38,950 --> 02:04:37,199
time it takes off the time it lands

3034
02:04:40,950 --> 02:04:38,960
what we do do on the ground is we plan

3035
02:04:41,589 --> 02:04:40,960
the flights and so we determine from

3036
02:04:49,510 --> 02:04:41,599
here

3037
02:04:52,950 --> 02:04:49,520
our experiment window is 30 martian days

3038
02:04:56,229 --> 02:04:52,960

so we have planned up to five flights

3039
02:04:57,030 --> 02:04:56,239
of incremental difficulty very first

3040
02:04:58,629 --> 02:04:57,040
flight the

3041
02:05:00,790 --> 02:04:58,639
main thing is we want to get the legs

3042
02:05:03,910 --> 02:05:00,800
off the ground and so we will

3043
02:05:05,350 --> 02:05:03,920
basically go up about three meters and

3044
02:05:07,270 --> 02:05:05,360
we'll hover there

3045
02:05:08,870 --> 02:05:07,280
and then we'll come down again and that

3046
02:05:11,669 --> 02:05:08,880
will be the first you know really

3047
02:05:13,350 --> 02:05:11,679
major milestone most of our flights will

3048
02:05:15,430 --> 02:05:13,360
be at the three to five meter height

3049
02:05:16,790 --> 02:05:15,440
we will be going horizontally again at a

3050
02:05:19,109 --> 02:05:16,800
few meters per second

3051
02:05:20,069 --> 02:05:19,119
probably go out you know 50 70 meters

3052
02:05:21,669 --> 02:05:20,079
and come back in

3053
02:05:23,430 --> 02:05:21,679
successive flights we'll probably push

3054
02:05:25,510 --> 02:05:23,440
that further try to go further

3055
02:05:27,430 --> 02:05:25,520
so our priority will be to get back

3056
02:05:28,069 --> 02:05:27,440
engineering telemetry and not so much

3057
02:05:29,830 --> 02:05:28,079
images

3058
02:05:32,790 --> 02:05:29,840
but i'm sure we'll return a few you know

3059
02:05:35,510 --> 02:05:32,800
because they'll always look cool

3060
02:05:36,149 --> 02:05:35,520
at this point we've tested all we can on

3061
02:05:38,310 --> 02:05:36,159
earth

3062
02:05:40,310 --> 02:05:38,320
we have mathematical models that shows

3063
02:05:40,709 --> 02:05:40,320

how it will fly at mars and we've tested

3064
02:05:42,950 --> 02:05:40,719
it

3065
02:05:44,390 --> 02:05:42,960
in the simulated environment that we can

3066
02:05:47,270 --> 02:05:44,400
create on earth

3067
02:05:48,950 --> 02:05:47,280
it really is time now to do the real

3068
02:05:51,109 --> 02:05:48,960
flood types at mars

3069
02:05:53,109 --> 02:05:51,119
nothing is a given but we have done

3070
02:05:54,870 --> 02:05:53,119
everything we can in terms of a test

3071
02:05:56,550 --> 02:05:54,880
program here on earth the vehicle is

3072
02:05:58,310 --> 02:05:56,560
performing extremely well so far

3073
02:05:59,990 --> 02:05:58,320
it's been doing exactly the right thing

3074
02:06:01,270 --> 02:06:00,000
even right now and is bolted onto the

3075
02:06:02,870 --> 02:06:01,280
perseverance rover

3076
02:06:06,069 --> 02:06:02,880
so there's a very good chance that we'll

3077
02:06:08,709 --> 02:06:06,079
pull it off yes but it's still high risk

3078
02:06:09,830 --> 02:06:08,719
and none of us forget that you could

3079
02:06:12,470 --> 02:06:09,840
have a glitch that

3080
02:06:13,430 --> 02:06:12,480
you know could mean end of mission yes

3081
02:06:16,629 --> 02:06:13,440
it's going to be

3082
02:06:17,189 --> 02:06:16,639
exciting reacting to any surprises we

3083
02:06:20,790 --> 02:06:17,199
have

3084
02:06:21,669 --> 02:06:20,800
we can't wait what's really most

3085
02:06:24,069 --> 02:06:21,679
important is

3086
02:06:25,030 --> 02:06:24,079
everything we're learning here is for

3087
02:06:26,870 --> 02:06:25,040
the future

3088
02:06:32,950 --> 02:06:26,880

roto craft systems that we want to

3089
02:06:35,990 --> 02:06:35,109
mimi ong is the project manager for

3090
02:06:38,550 --> 02:06:36,000
ingenuity

3091
02:06:40,629 --> 02:06:38,560
she joins us now as they await a chance

3092
02:06:43,669 --> 02:06:40,639
to check out their helicopter

3093
02:06:45,990 --> 02:06:43,679
in the coming days welcome mimi

3094
02:06:48,069 --> 02:06:46,000
thank you marina oh my goodness we've

3095
02:06:49,830 --> 02:06:48,079
been talking about this for months mimi

3096
02:06:51,030 --> 02:06:49,840
did you ever think you'd be here at this

3097
02:06:52,709 --> 02:06:51,040
point i mean what's going on in your

3098
02:06:55,589 --> 02:06:52,719
head right now

3099
02:06:57,990 --> 02:06:55,599
this is super exciting now we have been

3100
02:06:59,109 --> 02:06:58,000
working on mars helicopter for over six

3101
02:07:01,270 --> 02:06:59,119
years

3102
02:07:03,030 --> 02:07:01,280
testing and carefully designing it for

3103
02:07:04,550 --> 02:07:03,040
operation at mars so what's going

3104
02:07:07,910 --> 02:07:04,560
through my mind

3105
02:07:12,310 --> 02:07:07,920
ingenuity mars helicopter is finally at

3106
02:07:14,790 --> 02:07:12,320
the destination that it is designed for

3107
02:07:16,709 --> 02:07:14,800
now that ingenuity is on mars what is

3108
02:07:18,790 --> 02:07:16,719
the timeline you hope to accomplish as

3109
02:07:20,870 --> 02:07:18,800
you move forward

3110
02:07:23,189 --> 02:07:20,880
we have a series of major milestones

3111
02:07:25,589 --> 02:07:23,199
between now and ingenuity's first flight

3112
02:07:27,350 --> 02:07:25,599
so tomorrow we'll turn on the helicopter

3113
02:07:27,990 --> 02:07:27,360

and its space station could confirm

3114
02:07:29,830 --> 02:07:28,000
health

3115
02:07:31,669 --> 02:07:29,840
after experiencing the dynamics through

3116
02:07:33,750 --> 02:07:31,679
the edl just now

3117
02:07:36,069 --> 02:07:33,760
and the next major milestone will be

3118
02:07:37,030 --> 02:07:36,079
when the rover deploys the helicopter to

3119
02:07:39,189 --> 02:07:37,040
the surface

3120
02:07:40,629 --> 02:07:39,199
and that marks the first moment that

3121
02:07:42,870 --> 02:07:40,639
ingenuity operates

3122
02:07:44,950 --> 02:07:42,880
on its own in a stand-alone manner and

3123
02:07:45,750 --> 02:07:44,960
surviving that first cold frigid night

3124
02:07:48,550 --> 02:07:45,760
of mars

3125
02:07:50,149 --> 02:07:48,560
will be a major milestone we'll execute

3126
02:07:52,310 --> 02:07:50,159
a series of checkouts

3127
02:07:53,990 --> 02:07:52,320
and then we will perform that very

3128
02:07:56,229 --> 02:07:54,000
important first flight

3129
02:07:57,830 --> 02:07:56,239
and if the first flight is successful we

3130
02:07:59,990 --> 02:07:57,840
have up to four more flights

3131
02:08:02,470 --> 02:08:00,000
in the 30 martian days that we have set

3132
02:08:04,069 --> 02:08:02,480
aside for our flight experiments

3133
02:08:06,790 --> 02:08:04,079
and that's when you finally can breathe

3134
02:08:12,709 --> 02:08:08,950
now why is it so important to have that

3135
02:08:16,229 --> 02:08:12,719
aerial dimension to space exploration

3136
02:08:18,870 --> 02:08:16,239
a helicopter flying far ahead of rovers

3137
02:08:20,709 --> 02:08:18,880
and astronauts in the future can provide

3138
02:08:22,790 --> 02:08:20,719

high definition

3139
02:08:24,390 --> 02:08:22,800
reconnaissance information for the

3140
02:08:25,990 --> 02:08:24,400
rovers and the astronauts before they

3141
02:08:29,350 --> 02:08:26,000
take the long journeys

3142
02:08:31,830 --> 02:08:29,360
and as importantly being able to fly

3143
02:08:33,189 --> 02:08:31,840
will enable us to get to places that we

3144
02:08:34,870 --> 02:08:33,199
cannot get to with

3145
02:08:37,510 --> 02:08:34,880
rovers and astronauts like sites of

3146
02:08:39,990 --> 02:08:37,520
steep cliffs deep inside crevices

3147
02:08:42,629 --> 02:08:40,000
areas of high scientific interest it

3148
02:08:44,310 --> 02:08:42,639
will be game changing

3149
02:08:46,149 --> 02:08:44,320
game changing is right and we've talked

3150
02:08:48,950 --> 02:08:46,159
about this a lot you've mentioned the

3151
02:08:53,030 --> 02:08:48,960
risk is huge mimi but the reward is high

3152
02:08:55,109 --> 02:08:53,040
what will be your greatest reward

3153
02:08:56,709 --> 02:08:55,119
you know our team started with the

3154
02:08:59,350 --> 02:08:56,719
question of whether

3155
02:09:01,109 --> 02:08:59,360
a helicopter can fly at mars given the

3156
02:09:03,270 --> 02:09:01,119
extremely thin environment

3157
02:09:04,950 --> 02:09:03,280
and we systematically demonstrated a

3158
02:09:07,350 --> 02:09:04,960
series of technical steps

3159
02:09:09,270 --> 02:09:07,360
we demonstrated lift first and then we

3160
02:09:11,830 --> 02:09:09,280
demonstrated lift and

3161
02:09:13,910 --> 02:09:11,840
the first ever powered control

3162
02:09:15,270 --> 02:09:13,920
rotorcraft flight in simulated mars

3163
02:09:17,510 --> 02:09:15,280

atmospheric density

3164
02:09:18,470 --> 02:09:17,520
and then we went on to build the full up

3165
02:09:21,270 --> 02:09:18,480
helicopter

3166
02:09:21,910 --> 02:09:21,280
that can not only fly but operate and

3167
02:09:25,109 --> 02:09:21,920
survive

3168
02:09:28,149 --> 02:09:25,119
autonomously at mars all under

3169
02:09:30,069 --> 02:09:28,159
1.8 kilograms about four pounds

3170
02:09:31,350 --> 02:09:30,079
and each of these major milestones have

3171
02:09:34,069 --> 02:09:31,360
been a first

3172
02:09:35,750 --> 02:09:34,079
and the success of each of these has

3173
02:09:37,990 --> 02:09:35,760
been so rewarding

3174
02:09:39,510 --> 02:09:38,000
and along the way the rewards just kept

3175
02:09:42,149 --> 02:09:39,520
coming and i have to tell you at this

3176
02:09:45,990 --> 02:09:42,159
moment it's going up exponentially

3177
02:09:49,350 --> 02:09:46,000
so after all these tests analysis

3178
02:09:52,950 --> 02:09:49,360
simulations and more tests on earth

3179
02:09:55,589 --> 02:09:52,960
our team now gets the chance to test

3180
02:09:57,189 --> 02:09:55,599
prove and learn how it works in the

3181
02:09:58,950 --> 02:09:57,199
actual environment of mars

3182
02:10:00,470 --> 02:09:58,960
our team can ask for a bigger reward

3183
02:10:03,189 --> 02:10:00,480
than that

3184
02:10:05,030 --> 02:10:03,199
oh mimi i'm so happy for you and your

3185
02:10:08,310 --> 02:10:05,040
team and now we're gonna take a question

3186
02:10:11,910 --> 02:10:08,320
from social media on instagram for you

3187
02:10:15,350 --> 02:10:11,920
at not vibhuti asks is the helicopter

3188
02:10:18,629 --> 02:10:15,360

going to be doing science

3189
02:10:20,629 --> 02:10:18,639
well the helicopter engineering is a

3190
02:10:23,109 --> 02:10:20,639
technology demonstration

3191
02:10:24,390 --> 02:10:23,119
and we are we are demonstrating the

3192
02:10:27,109 --> 02:10:24,400
ability to fly

3193
02:10:28,629 --> 02:10:27,119
and learning how to fly for the very

3194
02:10:29,910 --> 02:10:28,639
very first time

3195
02:10:32,390 --> 02:10:29,920
and so this is a technology

3196
02:10:34,709 --> 02:10:32,400
demonstration and a pathfinder for

3197
02:10:35,510 --> 02:10:34,719
future larger rotorcraft future missions

3198
02:10:37,589 --> 02:10:35,520
that will carry

3199
02:10:39,910 --> 02:10:37,599
much larger instruments so on this

3200
02:10:42,950 --> 02:10:39,920
mission we're not doing any science

3201
02:10:45,830 --> 02:10:42,960
we're concentrating on engineering

3202
02:10:48,550 --> 02:10:45,840
uh data how did the vehicle perform and

3203
02:10:50,790 --> 02:10:48,560
as you saw uh bob bell ram uh in the

3204
02:10:51,589 --> 02:10:50,800
video before we will be taking a few

3205
02:10:55,030 --> 02:10:51,599
color picture

3206
02:10:56,790 --> 02:10:55,040
flying

3207
02:10:59,030 --> 02:10:56,800
aerial vantage point but they'll be

3208
02:11:01,510 --> 02:10:59,040
icing on the cake for this one this is

3209
02:11:02,709 --> 02:11:01,520
all about engineering data and how do we

3210
02:11:05,750 --> 02:11:02,719
fly compared to

3211
02:11:08,229 --> 02:11:05,760
all our tests we have done on earth mimi

3212
02:11:10,390 --> 02:11:08,239
so much for your team and the future

3213
02:11:12,629 --> 02:11:10,400

generations of scientists and engineers

3214
02:11:14,950 --> 02:11:12,639
to look forward to

3215
02:11:16,629 --> 02:11:14,960
thank you thank you so much for joining

3216
02:11:18,870 --> 02:11:16,639
us mimi and good luck to your team with

3217
02:11:21,350 --> 02:11:18,880
that first test flight

3218
02:11:23,030 --> 02:11:21,360
thank you so much now we look forward to

3219
02:11:25,109 --> 02:11:23,040
the perseverance rover and

3220
02:11:26,550 --> 02:11:25,119
ingenuity helicopter beginning their

3221
02:11:28,870 --> 02:11:26,560
journeys on mars

3222
02:11:29,589 --> 02:11:28,880
as their adventures are just about to

3223
02:11:32,709 --> 02:11:29,599
start

3224
02:11:34,390 --> 02:11:32,719
go perseverance and go ingenuity back to

3225
02:11:37,910 --> 02:11:34,400
you raquel

3226
02:11:38,790 --> 02:11:37,920
thanks marina landing on mars is never

3227
02:11:41,910 --> 02:11:38,800
easy

3228
02:11:45,109 --> 02:11:41,920
but this team has persevered and nasa's

3229
02:11:46,470 --> 02:11:45,119
fifth rover is on the red planet you can

3230
02:11:47,510 --> 02:11:46,480
still hear them buzzing in the back

3231
02:11:49,510 --> 02:11:47,520
right now

3232
02:11:51,990 --> 02:11:49,520
and to get the latest updates on

3233
02:11:55,669 --> 02:11:52,000
perseverance as it explores mars

3234
02:11:56,709 --> 02:11:55,679
follow at nasa persevere on facebook and

3235
02:11:58,550 --> 02:11:56,719
twitter

3236
02:11:59,830 --> 02:11:58,560
i'd like to thank everyone watching for

3237
02:12:01,910 --> 02:11:59,840
joining us today

3238
02:12:04,069 --> 02:12:01,920

and to the students and teachers tuning

3239
02:12:05,350 --> 02:12:04,079
in we hope you learned a lot from

3240
02:12:07,830 --> 02:12:05,360
today's landing

3241
02:12:08,390 --> 02:12:07,840
and thank you for all your questions we

3242
02:12:11,109 --> 02:12:08,400
have a

3243
02:12:12,229 --> 02:12:11,119
news briefing coming up at 2 30 p.m

3244
02:12:14,149 --> 02:12:12,239
pacific time

3245
02:12:16,390 --> 02:12:14,159
that briefing will wrap up the day and

3246
02:12:17,430 --> 02:12:16,400
include reactions from perseverance team

3247
02:12:19,589 --> 02:12:17,440
members

3248
02:12:21,109 --> 02:12:19,599
we'll leave you now with some of the

3249
02:12:23,189 --> 02:12:21,119
landing celebration photos

3250
02:12:24,709 --> 02:12:23,199
you've shared with us set to

3251
02:12:27,910 --> 02:12:24,719
youngblood's cover of

3252
02:12:29,030 --> 02:12:27,920
david bowie's life on mars i'm raquel

3253
02:12:39,890 --> 02:12:29,040
villanueva

3254
02:13:18,950 --> 02:12:46,830
[Music]

3255
02:13:19,510 --> 02:13:18,960
[Applause]

3256
02:13:22,010 --> 02:13:19,520
[Music]

3257
02:13:26,709 --> 02:13:22,020
[Applause]

3258
02:13:56,830 --> 02:13:26,719
[Music]

3259
02:14:52,830 --> 02:13:58,760
is

3260
02:14:54,650 --> 02:14:52,840
[Music]

3261
02:14:58,290 --> 02:14:54,660
is

3262
02:15:36,190 --> 02:14:58,300
[Music]

3263
02:15:41,780 --> 02:15:36,200

oh

3264
02:15:48,830 --> 02:15:42,250
[Applause]

3265
02:15:50,060 --> 02:15:48,840
[Music]