NASA LIVE

PERSEVERANCE MARS ROVER LANDING

1
00:00:59,189 --> 00:00:57,270
as the countdown to mars continues the

2
00:01:01,349 --> 00:00:59,199
perseverance of humanity launching the

3
00:01:43,190 --> 00:01:01,359
next generation of robotic explorers to

4
00:01:48,310 --> 00:01:45,270
welcome to nasa's jet propulsion

5
00:01:50,630 --> 00:01:48,320
laboratory in southern california we are

6
00:01:52,710 --> 00:01:50,640
gearing up for nasa's perseverance rover

7
00:01:55,109 --> 00:01:52,720
to touch down on mars

8
00:01:57,030 --> 00:01:55,119
happening in an hour and a half from now

9
00:01:59,749 --> 00:01:57,040
the rover will attempt to land in

10
00:02:03,109 --> 00:01:59,759
jezreel crater it is the most difficult

11
00:02:05,590 --> 00:02:03,119
landing site on mars ever attempted

12
00:02:07,670 --> 00:02:05,600
thank you for joining us i'm your host

13
00:02:09,910 --> 00:02:07,680

raquel villanueva

14
00:02:11,589 --> 00:02:09,920
in the past mission team members

15
00:02:12,710 --> 00:02:11,599
gathered in our mission control for

16
00:02:15,030 --> 00:02:12,720
landings

17
00:02:16,790 --> 00:02:15,040
but this time around we have coveted

18
00:02:18,470 --> 00:02:16,800
safety measures in place

19
00:02:20,550 --> 00:02:18,480
today's landing will look a little

20
00:02:22,470 --> 00:02:20,560
different than what you've seen before

21
00:02:24,550 --> 00:02:22,480
i am in a room by myself

22
00:02:26,630 --> 00:02:24,560
and so is my co-host

23
00:02:29,190 --> 00:02:26,640
here in the space flight operations

24
00:02:31,350 --> 00:02:29,200
facility team members are in different

25
00:02:32,710 --> 00:02:31,360
parts of this building some are in

26
00:02:34,830 --> 00:02:32,720
mission control

27
00:02:38,229 --> 00:02:34,840
others are upstairs for landing

28
00:02:40,470 --> 00:02:38,239
operations we also have isolated rooms

29
00:02:43,190 --> 00:02:40,480
for our guests on the show

30
00:02:45,990 --> 00:02:43,200
in total we have eight locations covered

31
00:02:47,030 --> 00:02:46,000
by 14 robotic cameras that you will be

32
00:02:50,070 --> 00:02:47,040
seeing

33
00:02:53,509 --> 00:02:50,080
one of those locations is the dark room

34
00:02:55,910 --> 00:02:53,519
the heart of nasa's deep space network

35
00:02:57,190 --> 00:02:55,920
think of it as a giant communication

36
00:02:59,589 --> 00:02:57,200
switchboard

37
00:03:02,309 --> 00:02:59,599
this is where spacecraft phone home to

38
00:03:04,869 --> 00:03:02,319

us from across the solar system and

39
00:03:07,030 --> 00:03:04,879
interstellar space the deep space

40
00:03:08,710 --> 00:03:07,040
network has been tracking perseverance

41
00:03:11,750 --> 00:03:08,720
since it left earth

42
00:03:13,110 --> 00:03:11,760
and there are lots of ways you can watch

43
00:03:16,710 --> 00:03:13,120
landing today

44
00:03:19,350 --> 00:03:16,720
we have a 360 degree camera inside the

45
00:03:21,670 --> 00:03:19,360
control room it lets you experience the

46
00:03:23,350 --> 00:03:21,680
landing right along with the team while

47
00:03:26,630 --> 00:03:23,360
seeing this broadcast

48
00:03:29,350 --> 00:03:26,640
we also have the clean feed it shows an

49
00:03:34,470 --> 00:03:29,360
uninterrupted view of mission control

50
00:03:41,190 --> 00:03:36,710
to tell us about it is host diana

51
00:03:43,270 --> 00:03:41,200
trujillo who also works on the mission

52
00:03:45,589 --> 00:03:43,280
thank you raquel we're so excited to be

53
00:03:46,550 --> 00:03:45,599
the sister live broadcast in spanish

54
00:03:48,229 --> 00:03:46,560
synthony

55
00:03:55,750 --> 00:03:48,239
program

56
00:03:55,760 --> 00:04:06,070
participation

57
00:04:10,309 --> 00:04:08,229
and don't forget we want to see how you

58
00:04:12,390 --> 00:04:10,319
are watching the landing today use the

59
00:04:14,789 --> 00:04:12,400
hashtag countdown to mars to send us

60
00:04:17,349 --> 00:04:14,799
your photos and videos to preview what

61
00:04:21,509 --> 00:04:17,359
interviews are coming up is my co-host

62
00:04:23,990 --> 00:04:21,519
from the jpl news office marina jurica

63
00:04:26,150 --> 00:04:24,000

thanks so much raquel the excitement is

64
00:04:28,070 --> 00:04:26,160
building behind me right here in mission

65
00:04:30,550 --> 00:04:28,080
control as we count down to the

66
00:04:32,710 --> 00:04:30,560
perseverance landing we will be talking

67
00:04:34,870 --> 00:04:32,720
to some of the many people who made

68
00:04:37,830 --> 00:04:34,880
today possible from scientists to

69
00:04:39,670 --> 00:04:37,840
engineers on the mars 2020 perseverance

70
00:04:41,430 --> 00:04:39,680
rover team to folks from nasa

71
00:04:44,230 --> 00:04:41,440
headquarters giving us a look into the

72
00:04:46,230 --> 00:04:44,240
future of mars exploration a little

73
00:04:48,150 --> 00:04:46,240
later we will also be speaking with the

74
00:04:51,189 --> 00:04:48,160
students who named the rover and the

75
00:04:54,230 --> 00:04:51,199
helicopter inspirational stories as we

76
00:04:57,350 --> 00:04:54,240
prepare for another landing on the red

77
00:04:59,749 --> 00:04:57,360
planet back to you raquel

78
00:05:01,909 --> 00:04:59,759
thanks marina let's give a shout out to

79
00:05:04,150 --> 00:05:01,919
the students around the nation learning

80
00:05:06,629 --> 00:05:04,160
about perseverance's mission to mars

81
00:05:09,029 --> 00:05:06,639
with their teachers we're happier with

82
00:05:10,870 --> 00:05:09,039
us on this exciting day later in the

83
00:05:12,710 --> 00:05:10,880
show we will be answering some of the

84
00:05:14,230 --> 00:05:12,720
questions you submitted through your

85
00:05:17,830 --> 00:05:14,240
classrooms

86
00:05:20,230 --> 00:05:17,840
landing on mars is complex the team will

87
00:05:22,710 --> 00:05:20,240
be calling out milestones as they happen

88
00:05:25,430 --> 00:05:22,720

it's fast-paced and you'll hear lots of

89
00:05:27,510 --> 00:05:25,440
technical terms to help us translate and

90
00:05:30,790 --> 00:05:27,520
explain what is going on in mission

91
00:05:33,029 --> 00:05:30,800
control is swati mohan she is part of

92
00:05:34,469 --> 00:05:33,039
perseverance's landing team

93
00:05:37,189 --> 00:05:34,479
thanks for guiding us through landing

94
00:05:40,070 --> 00:05:37,199
today swati hi raquel i'm happy to be

95
00:05:42,469 --> 00:05:40,080
here today so swati what is the status

96
00:05:44,870 --> 00:05:42,479
of the perseverance rover right now so

97
00:05:48,790 --> 00:05:44,880
perseverance is still in space right now

98
00:05:50,830 --> 00:05:48,800
about 9 000 miles from mars so far she

99
00:05:53,909 --> 00:05:50,840
is healthy and on

100
00:05:55,990 --> 00:05:53,919
course and it takes time to send signals

101
00:05:57,670 --> 00:05:56,000
between earth and mars can you let us

102
00:05:59,029 --> 00:05:57,680
know how that affects the information

103
00:06:00,590 --> 00:05:59,039
you are seeing

104
00:06:04,150 --> 00:06:00,600
so mars is about

105
00:06:06,550 --> 00:06:04,160
127 million miles from earth right now

106
00:06:09,749 --> 00:06:06,560
that means it takes about 11 minutes

107
00:06:11,350 --> 00:06:09,759
from lights to travel from mars

108
00:06:12,150 --> 00:06:11,360
to earth

109
00:06:14,230 --> 00:06:12,160
so

110
00:06:16,629 --> 00:06:14,240
all the information that we receive from

111
00:06:17,990 --> 00:06:16,639
perseverance actually happened 11

112
00:06:21,590 --> 00:06:18,000
minutes ago

113
00:06:24,710 --> 00:06:21,600

so the round trip is 22 minutes for us

114
00:06:26,710 --> 00:06:24,720
to send a command to perseverance and

115
00:06:28,390 --> 00:06:26,720
hear back on the ground that she's

116
00:06:30,870 --> 00:06:28,400
received that command this is what we

117
00:06:33,350 --> 00:06:30,880
call two-way light time

118
00:06:35,189 --> 00:06:33,360
that's good to know and can you tell us

119
00:06:36,150 --> 00:06:35,199
who else is in the room with you right

120
00:06:38,469 --> 00:06:36,160
now

121
00:06:39,830 --> 00:06:38,479
the operations team is split into two

122
00:06:42,150 --> 00:06:39,840
different areas

123
00:06:45,270 --> 00:06:42,160
here in the cruise mission support area

124
00:06:48,629 --> 00:06:45,280
we have primarily the team that has been

125
00:06:51,749 --> 00:06:48,639
flying perseverance from earth to mars

126
00:06:54,390 --> 00:06:51,759
you'll see the placards with the roles

127
00:06:56,390 --> 00:06:54,400
of each of the people by their stations

128
00:06:59,350 --> 00:06:56,400
some of the people you may hear

129
00:07:01,990 --> 00:06:59,360
talking today are the flight director

130
00:07:03,430 --> 00:07:02,000
who is the conductor of our operations

131
00:07:06,390 --> 00:07:03,440
orchestra here

132
00:07:09,749 --> 00:07:06,400
the entry descent and landing activity

133
00:07:12,150 --> 00:07:09,759
lead who is a member of the landing team

134
00:07:14,150 --> 00:07:12,160
tasked with understanding the execution

135
00:07:16,950 --> 00:07:14,160
of entry descent and landing

136
00:07:19,589 --> 00:07:16,960
and then also the telecommunications and

137
00:07:22,150 --> 00:07:19,599
entry descent and landing communications

138
00:07:23,830 --> 00:07:22,160

engineers who will be monitoring the

139
00:07:25,909 --> 00:07:23,840
signal from perseverance through the

140
00:07:29,589 --> 00:07:25,919
different paths that we have

141
00:07:32,070 --> 00:07:29,599
upstairs in what we call the war room we

142
00:07:35,270 --> 00:07:32,080
have almost the entire entry descent and

143
00:07:37,589 --> 00:07:35,280
landing operations team and then across

144
00:07:38,629 --> 00:07:37,599
the hall from them we have this surface

145
00:07:40,629 --> 00:07:38,639
mission

146
00:07:43,270 --> 00:07:40,639
control room where the surface

147
00:07:45,270 --> 00:07:43,280
operations team is ready and waiting to

148
00:07:47,029 --> 00:07:45,280
take over as soon as perseverances will

149
00:07:50,150 --> 00:07:47,039
touch the ground

150
00:07:51,909 --> 00:07:50,160
and you have been part of this mission

151
00:07:53,110 --> 00:07:51,919
for years now

152
00:07:54,150 --> 00:07:53,120
can you tell us what have you been

153
00:07:59,670 --> 00:07:54,160
working on

154
00:08:01,350 --> 00:07:59,680
almost eight years now as a guidance

155
00:08:02,710 --> 00:08:01,360
navigation control

156
00:08:04,790 --> 00:08:02,720
engineer

157
00:08:06,629 --> 00:08:04,800
working primarily on entry descent and

158
00:08:09,189 --> 00:08:06,639
landing one of my

159
00:08:11,670 --> 00:08:09,199
big tasks was to help with terrain

160
00:08:13,670 --> 00:08:11,680
relative navigation perseverance will be

161
00:08:16,150 --> 00:08:13,680
the first mission to fly terrain

162
00:08:18,469 --> 00:08:16,160
relative navigation so while she's

163
00:08:21,350 --> 00:08:18,479

descending on the parachute she'll

164
00:08:22,309 --> 00:08:21,360
actually be looking at the ground with a

165
00:08:24,150 --> 00:08:22,319
camera

166
00:08:26,629 --> 00:08:24,160
seeing where she is with respect to the

167
00:08:29,589 --> 00:08:26,639
martian surface and choosing

168
00:08:31,749 --> 00:08:29,599
a safe spot to land that she can get to

169
00:08:33,029 --> 00:08:31,759
after so many years of working on the

170
00:08:34,870 --> 00:08:33,039
mission it's

171
00:08:36,149 --> 00:08:34,880
an honor to be here today as the mission

172
00:08:37,589 --> 00:08:36,159
commentator

173
00:08:39,670 --> 00:08:37,599
we're happy to have you here thanks

174
00:08:42,149 --> 00:08:39,680
swati we'll be checking back in with you

175
00:08:44,550 --> 00:08:42,159
in just a few minutes as perseverance

176
00:08:45,990 --> 00:08:44,560
approaches its next milestone

177
00:08:47,750 --> 00:08:46,000
but for now

178
00:08:53,269 --> 00:08:47,760
let's learn more about the rover's

179
00:08:58,150 --> 00:08:55,910
you know mars is the closest place that

180
00:08:59,829 --> 00:08:58,160
we can reach with robotic exploration

181
00:09:01,430 --> 00:08:59,839
that we think had a really good chance

182
00:09:03,670 --> 00:09:01,440
of having ancient life

183
00:09:05,750 --> 00:09:03,680
the perseverance rover will land at a

184
00:09:07,750 --> 00:09:05,760
location called jezreel crater

185
00:09:08,710 --> 00:09:07,760
jezreel crater is a very interesting

186
00:09:11,030 --> 00:09:08,720
place

187
00:09:12,710 --> 00:09:11,040
it's a crater that once held a lake

188
00:09:14,389 --> 00:09:12,720

there are a lot of craters on the

189
00:09:16,710 --> 00:09:14,399
surface of mars that could have once

190
00:09:18,870 --> 00:09:16,720
hosted ancient lakes but not every

191
00:09:20,870 --> 00:09:18,880
crater that we think had a lake actually

192
00:09:23,030 --> 00:09:20,880
preserves evidence that that lake was

193
00:09:25,030 --> 00:09:23,040
there it had an inflow channel and it

194
00:09:27,590 --> 00:09:25,040
had an outflow channel that means it was

195
00:09:29,750 --> 00:09:27,600
filled the crater was filled with water

196
00:09:31,670 --> 00:09:29,760
in jezreel we have probably one of the

197
00:09:35,030 --> 00:09:31,680
most beautifully preserved delta

198
00:09:36,870 --> 00:09:35,040
deposits on mars in that crater

199
00:09:39,030 --> 00:09:36,880
this is a wonderful place to live for

200
00:09:41,670 --> 00:09:39,040
microorganisms and it is also a

201
00:09:44,150 --> 00:09:41,680
wonderful place for those microorganisms

202
00:09:46,230 --> 00:09:44,160
to be preserved so that we can find them

203
00:09:48,070 --> 00:09:46,240
now so many billions of years later

204
00:09:50,790 --> 00:09:48,080
there is no other place on mars that has

205
00:09:52,550 --> 00:09:50,800
the unique combination of a lake setting

206
00:09:54,070 --> 00:09:52,560
a beautifully preserved delta and the

207
00:09:56,630 --> 00:09:54,080
diverse mineralogy that we have in

208
00:09:58,230 --> 00:09:56,640
jezreel crater so it's truly a special

209
00:10:00,470 --> 00:09:58,240
landing site

210
00:10:02,230 --> 00:10:00,480
the major goal of the perseverance

211
00:10:04,790 --> 00:10:02,240
mission is to

212
00:10:06,790 --> 00:10:04,800
investigate astrobiology on mars and in

213
00:10:10,069 --> 00:10:06,800

particular to address the question of

214
00:10:11,750 --> 00:10:10,079
whether life ever existed on mars

215
00:10:13,750 --> 00:10:11,760
the perseverance rover starts with

216
00:10:15,670 --> 00:10:13,760
design that's very similar to curiosity

217
00:10:17,670 --> 00:10:15,680
we've added to it a whole new set of

218
00:10:20,310 --> 00:10:17,680
science instruments and these science

219
00:10:22,069 --> 00:10:20,320
instruments were purposefully selected

220
00:10:23,829 --> 00:10:22,079
to help us in the search for

221
00:10:25,350 --> 00:10:23,839
biosignatures

222
00:10:28,310 --> 00:10:25,360
we're going to be taking

223
00:10:29,750 --> 00:10:28,320
microphones with us for the first time

224
00:10:33,430 --> 00:10:29,760
we're going to have

225
00:10:35,590 --> 00:10:33,440
that human sense on another planet

226
00:10:39,110 --> 00:10:35,600
perseverance carries with her a grand

227
00:10:41,990 --> 00:10:39,120
experiment in space fairing technology a

228
00:10:44,630 --> 00:10:42,000
helicopter the name of which is now

229
00:10:47,350 --> 00:10:44,640
ingenuity one of the major upgrades that

230
00:10:49,990 --> 00:10:47,360
perseverance has from curiosity is that

231
00:10:53,430 --> 00:10:50,000
it's able to self-drive for a distance

232
00:10:55,750 --> 00:10:53,440
of up to 200 meters per day as the rover

233
00:10:59,590 --> 00:10:55,760
is driving it's literally building the

234
00:11:01,590 --> 00:10:59,600
map of the road it's driving on on mars

235
00:11:03,750 --> 00:11:01,600
scientists for years have told us that

236
00:11:05,509 --> 00:11:03,760
to really unlock

237
00:11:08,069 --> 00:11:05,519
the secrets of mars we have to bring

238
00:11:11,509 --> 00:11:08,079

samples from mars back to earth so what

239
00:11:12,870 --> 00:11:11,519
marsh 2020 is going to do is to

240
00:11:15,350 --> 00:11:12,880
drill samples

241
00:11:17,990 --> 00:11:15,360
put them in small tubes we're going to

242
00:11:19,829 --> 00:11:18,000
seal it in its own individual tube we

243
00:11:22,389 --> 00:11:19,839
set them on the surface to provide a

244
00:11:24,310 --> 00:11:22,399
target for the second two missions

245
00:11:25,670 --> 00:11:24,320
which hopefully will get in development

246
00:11:27,590 --> 00:11:25,680
in the next several years and could

247
00:11:30,069 --> 00:11:27,600
potentially get the samples back to

248
00:11:33,269 --> 00:11:30,079
earth by 2031.

249
00:11:34,550 --> 00:11:33,279
perseverance is a very very profound

250
00:11:37,110 --> 00:11:34,560
first step

251
00:11:38,550 --> 00:11:37,120
in both our understanding

252
00:11:39,829 --> 00:11:38,560
of our place

253
00:11:40,710 --> 00:11:39,839
in the universe

254
00:11:42,310 --> 00:11:40,720
and

255
00:11:45,320 --> 00:11:42,320
a stepping stone towards human

256
00:11:49,190 --> 00:11:45,330
exploration on mars

257
00:11:53,829 --> 00:11:51,509
you are watching live mars landing

258
00:11:56,790 --> 00:11:53,839
commentary and perseverance is about to

259
00:11:58,870 --> 00:11:56,800
reach another important milestone swati

260
00:12:01,110 --> 00:11:58,880
can you tell us what is happening

261
00:12:03,829 --> 00:12:01,120
we are at a milestone where the

262
00:12:05,509 --> 00:12:03,839
operations team determines whether

263
00:12:08,310 --> 00:12:05,519

they're ready to turn off the

264
00:12:10,870 --> 00:12:08,320
transmitter to perseverance turning off

265
00:12:13,269 --> 00:12:10,880
the transmitter is like taking your

266
00:12:16,310 --> 00:12:13,279
hands off of the wheel at this point

267
00:12:18,629 --> 00:12:16,320
ford perseverance would be on her own to

268
00:12:25,829 --> 00:12:18,639
execute entry descent and landing over

269
00:12:30,310 --> 00:12:26,870
go

270
00:12:31,269 --> 00:12:30,320
art lead

271
00:12:32,629 --> 00:12:31,279
go

272
00:12:33,509 --> 00:12:32,639
team chief

273
00:12:34,389 --> 00:12:33,519
go

274
00:12:36,150 --> 00:12:34,399
ace

275
00:12:40,389 --> 00:12:36,160
go

276
00:12:41,430 --> 00:12:40,399
deputy mission

277
00:12:45,670 --> 00:12:41,440
go

278
00:12:53,110 --> 00:12:45,680
mission assurance

279
00:12:56,790 --> 00:12:54,790
chief is go

280
00:12:58,710 --> 00:12:56,800
project manager

281
00:13:01,030 --> 00:12:58,720
projects go

282
00:13:03,269 --> 00:13:01,040
mission manager all stations are go for

283
00:13:07,829 --> 00:13:03,279
transmitter off

284
00:13:12,389 --> 00:13:09,990
there you have it raquel we have deemed

285
00:13:15,430 --> 00:13:12,399
perseverance ready to execute entry

286
00:13:17,430 --> 00:13:15,440
descent and landing on her own

287
00:13:20,150 --> 00:13:17,440
thank you swati as we just heard

288
00:13:22,870 --> 00:13:20,160

perseverance is now operating on its own

289
00:13:24,949 --> 00:13:22,880
as it cruises closer to mars

290
00:13:27,590 --> 00:13:24,959
to help explain what this mission means

291
00:13:30,230 --> 00:13:27,600
for the agency is nasa's associate

292
00:13:32,790 --> 00:13:30,240
administrator thomas zurbukin

293
00:13:35,910 --> 00:13:32,800
thomas this is our fifth rover sent to

294
00:13:37,990 --> 00:13:35,920
mars since 1997 can you tell us how

295
00:13:39,350 --> 00:13:38,000
perseverance is going to kick-start a

296
00:13:41,670 --> 00:13:39,360
new era

297
00:13:43,509 --> 00:13:41,680
wow this is such an important date today

298
00:13:46,230 --> 00:13:43,519
and and it really is the beginning of a

299
00:13:48,230 --> 00:13:46,240
new era in a sense that we're going from

300
00:13:51,750 --> 00:13:48,240
exploration can offer

301
00:13:53,509 --> 00:13:51,760
experiments on rovers looking around

302
00:13:55,990 --> 00:13:53,519
doing analysis

303
00:13:59,189 --> 00:13:56,000
to the sample return phase in which

304
00:14:02,629 --> 00:13:59,199
we're not only looking around looking at

305
00:14:04,389 --> 00:14:02,639
the geology but really turning our rower

306
00:14:07,590 --> 00:14:04,399
into a robotic geologist and

307
00:14:09,030 --> 00:14:07,600
astrobiologist collecting samples that

308
00:14:11,189 --> 00:14:09,040
we will bring

309
00:14:13,509 --> 00:14:11,199
back to earth and for us of course those

310
00:14:15,269 --> 00:14:13,519
are where the best laboratories are of

311
00:14:17,350 --> 00:14:15,279
all of humanity some of them still

312
00:14:19,990 --> 00:14:17,360
remain to be explored by some that are

313
00:14:21,750 --> 00:14:20,000

not yet in the science community yet and

314
00:14:23,829 --> 00:14:21,760
that's what we're looking forward to

315
00:14:26,069 --> 00:14:23,839
it's that new face the other element

316
00:14:27,430 --> 00:14:26,079
that i want to talk about is the amazing

317
00:14:29,430 --> 00:14:27,440
technologies that are there and of

318
00:14:32,069 --> 00:14:29,440
course one of my favorites is the

319
00:14:34,230 --> 00:14:32,079
ingenuity helicopter this in search of

320
00:14:36,230 --> 00:14:34,240
this extraterrestrial wright brothers

321
00:14:39,110 --> 00:14:36,240
moment you know controlled flight for

322
00:14:42,230 --> 00:14:39,120
the first time elsewhere raquel

323
00:14:45,829 --> 00:14:42,240
great and we have a student question on

324
00:14:48,310 --> 00:14:45,839
video for you from macy

325
00:14:49,990 --> 00:14:48,320
hi my name is macy ragsdale

326
00:14:52,310 --> 00:14:50,000
my question is

327
00:14:54,389 --> 00:14:52,320
is anything alive on mars

328
00:14:56,870 --> 00:14:54,399
thank you

329
00:14:58,870 --> 00:14:56,880
well macy i'm so glad for your question

330
00:15:00,949 --> 00:14:58,880
that's a question i ask myself is

331
00:15:03,030 --> 00:15:00,959
anything alive there and frankly at the

332
00:15:05,829 --> 00:15:03,040
surface where we're going right now with

333
00:15:08,310 --> 00:15:05,839
uh perseverance we do not believe

334
00:15:09,910 --> 00:15:08,320
there's anything alive uh right there

335
00:15:11,990 --> 00:15:09,920
because of the radiation that's there

336
00:15:13,990 --> 00:15:12,000
it's chilling cold and there's really no

337
00:15:16,710 --> 00:15:14,000
water there but guess what

338
00:15:18,949 --> 00:15:16,720

we think that three billion years ago

339
00:15:21,269 --> 00:15:18,959
this looked like a stream that you may

340
00:15:22,870 --> 00:15:21,279
see on earth and frankly a lot more

341
00:15:24,870 --> 00:15:22,880
similar than earth but water with a

342
00:15:28,310 --> 00:15:24,880
magnetic field just like the earth with

343
00:15:30,150 --> 00:15:28,320
an atmosphere and the question is

344
00:15:31,509 --> 00:15:30,160
at that time three billion years ago

345
00:15:33,509 --> 00:15:31,519
were there

346
00:15:35,910 --> 00:15:33,519
single cell organisms just of the type

347
00:15:38,230 --> 00:15:35,920
that developed on earth so is there life

348
00:15:39,749 --> 00:15:38,240
on on mars overall we don't know but

349
00:15:41,829 --> 00:15:39,759
where we're going right now we're really

350
00:15:44,230 --> 00:15:41,839
looking for ancient life and that's what

351
00:15:46,710 --> 00:15:44,240
we're so excited about

352
00:15:48,550 --> 00:15:46,720
thank you for your time today thomas and

353
00:15:51,350 --> 00:15:48,560
thanks to everyone who has been using

354
00:15:53,670 --> 00:15:51,360
the hashtag countdown to mars

355
00:15:56,949 --> 00:15:53,680
here are some of the photos that you've

356
00:16:00,790 --> 00:15:56,959
sent in so far let's take a look

357
00:16:06,470 --> 00:16:00,800
now please keep sharing with us how you

358
00:16:11,430 --> 00:16:09,269
for now let's go back to swati for an

359
00:16:14,069 --> 00:16:11,440
important update to what's going on in

360
00:16:16,310 --> 00:16:14,079
mission control as we get closer to

361
00:16:19,030 --> 00:16:16,320
another milestone

362
00:16:21,269 --> 00:16:19,040
hey raquel this next milestone is a

363
00:16:23,430 --> 00:16:21,279

communications poll so

364
00:16:26,710 --> 00:16:23,440
during landing not only will

365
00:16:29,110 --> 00:16:26,720
perseverance talk directly to earth but

366
00:16:31,670 --> 00:16:29,120
we'll also be talking to two spacecraft

367
00:16:33,509 --> 00:16:31,680
that are currently orbiting mars the

368
00:16:35,749 --> 00:16:33,519
mars reconnaissance orbiter and the

369
00:16:37,749 --> 00:16:35,759
maven spacecraft

370
00:16:40,230 --> 00:16:37,759
this pool is to confirm with the mars

371
00:16:41,990 --> 00:16:40,240
reconnaissance orbiter spacecraft

372
00:16:45,030 --> 00:16:42,000
and the maven spacecraft teams that they

373
00:16:52,389 --> 00:16:45,040
are ready and on track to support the

374
00:16:52,399 --> 00:17:14,150
crackers

375
00:17:18,470 --> 00:17:16,150
have you performed the contract and

376
00:17:19,990 --> 00:17:18,480
readiness of the orbiters

377
00:17:22,230 --> 00:17:20,000
we have performed the voice check and

378
00:17:23,829 --> 00:17:22,240
the readiness poll and can confirm that

379
00:17:26,710 --> 00:17:23,839
mro maven

380
00:17:28,710 --> 00:17:26,720
eda radio science one and two uhf dte

381
00:17:30,870 --> 00:17:28,720
csn and edl gdds are all ready to

382
00:17:38,950 --> 00:17:30,880
support

383
00:17:44,070 --> 00:17:41,350
so we've just heard that

384
00:17:46,070 --> 00:17:44,080
we have a confirmation from each of the

385
00:17:47,750 --> 00:17:46,080
different orbiters and all of their

386
00:17:50,150 --> 00:17:47,760
support equipment on the ground that

387
00:17:52,070 --> 00:17:50,160
they are ready and

388
00:17:55,510 --> 00:17:52,080

are on track to support the relay from

389
00:17:59,830 --> 00:17:58,150
great thank you swati and we just heard

390
00:18:01,830 --> 00:17:59,840
that communications readiness poll which

391
00:18:04,950 --> 00:18:01,840
means we are ready to relay the data

392
00:18:07,430 --> 00:18:04,960
perseverance will send to get a better

393
00:18:10,789 --> 00:18:07,440
idea of what the rover looks like as it

394
00:18:13,590 --> 00:18:10,799
approaches mars we have a nasa program

395
00:18:16,310 --> 00:18:13,600
called eyes the visualization lets

396
00:18:19,909 --> 00:18:16,320
anyone watching track perseverance

397
00:18:23,830 --> 00:18:21,590
follow perseverance on its journey to

398
00:18:25,510 --> 00:18:23,840
the surface of the red planet with eyes

399
00:18:29,150 --> 00:18:25,520
on the solar system

400
00:18:31,909 --> 00:18:29,160
from your desktop or mobile device go to

401
00:18:34,310 --> 00:18:31,919
eyes.nasa.gov click on the banner and

402
00:18:37,990 --> 00:18:34,320
now you're with perseverance in real

403
00:18:40,150 --> 00:18:38,000
time through every step of edl entry

404
00:18:42,470 --> 00:18:40,160
descent and landing

405
00:18:44,470 --> 00:18:42,480
this interactive experience lets you

406
00:18:45,510 --> 00:18:44,480
ride along from whatever perspective you

407
00:18:47,909 --> 00:18:45,520
choose

408
00:18:49,270 --> 00:18:47,919
click and drag scroll in

409
00:18:50,549 --> 00:18:49,280
scroll out

410
00:18:52,950 --> 00:18:50,559
check out the descriptions and

411
00:18:54,789 --> 00:18:52,960
explanations to increase your edl

412
00:18:56,950 --> 00:18:54,799
expertise

413
00:18:59,350 --> 00:18:56,960

experience every entry descent and

414
00:19:02,070 --> 00:18:59,360
landing event precisely designed and

415
00:19:03,430 --> 00:19:02,080
executed to land perseverance safely on

416
00:19:05,190 --> 00:19:03,440
mars

417
00:19:07,350 --> 00:19:05,200
the eyes experience is based on

418
00:19:08,950 --> 00:19:07,360
predictive data but during this

419
00:19:11,750 --> 00:19:08,960
broadcast you'll see a different

420
00:19:13,909 --> 00:19:11,760
visualization called ranger and it's

421
00:19:15,750 --> 00:19:13,919
based on the real communication the team

422
00:19:18,549 --> 00:19:15,760
and mission control receives from

423
00:19:20,710 --> 00:19:18,559
perseverance in near real time

424
00:19:23,190 --> 00:19:20,720
this is the visualization the team will

425
00:19:25,510 --> 00:19:23,200
follow as data fills their screens while

426
00:19:27,750 --> 00:19:25,520
monitoring the health of perseverance on

427
00:19:29,909 --> 00:19:27,760
its nerve-racking course to another

428
00:19:31,970 --> 00:19:29,919
successful mars landing

429
00:19:50,070 --> 00:19:31,980
enjoy the ride

430
00:19:54,630 --> 00:19:52,390
you are watching live mars landing

431
00:19:57,110 --> 00:19:54,640
commentary stepping outside mission

432
00:19:59,830 --> 00:19:57,120
control to talk to us is perseverance

433
00:20:01,750 --> 00:19:59,840
system engineer matt smith

434
00:20:02,710 --> 00:20:01,760
thanks for joining us today matt hey

435
00:20:04,789 --> 00:20:02,720
raquel

436
00:20:07,029 --> 00:20:04,799
well coming from mission control we are

437
00:20:08,950 --> 00:20:07,039
going to hear terms related to landing

438
00:20:09,990 --> 00:20:08,960

can you help us understand what some of

439
00:20:12,149 --> 00:20:10,000
them mean

440
00:20:14,390 --> 00:20:12,159
sure definitely um one thing you'll hear

441
00:20:16,149 --> 00:20:14,400
a lot about is telemetry so telemetry is

442
00:20:17,510 --> 00:20:16,159
just our way of talking about data

443
00:20:19,110 --> 00:20:17,520
that's coming from the spacecraft and

444
00:20:21,350 --> 00:20:19,120
telling us important things like

445
00:20:23,029 --> 00:20:21,360
temperatures on the vehicle pressure how

446
00:20:24,870 --> 00:20:23,039
much fuel we have left and other things

447
00:20:27,350 --> 00:20:24,880
that we need to understand for the

448
00:20:29,190 --> 00:20:27,360
health and safety of the vehicle

449
00:20:31,510 --> 00:20:29,200
you'll also hear the word nominal

450
00:20:34,630 --> 00:20:31,520
hopefully nominal means everything is

451
00:20:35,669 --> 00:20:34,640
expected everything is okay we're good

452
00:20:38,230 --> 00:20:35,679
to go

453
00:20:40,630 --> 00:20:38,240
uh you'll hear also a lot about velocity

454
00:20:42,630 --> 00:20:40,640
and deceleration so velocity is just our

455
00:20:45,430 --> 00:20:42,640
speed combined with the direction we're

456
00:20:47,830 --> 00:20:45,440
going and deceleration is our slowing

457
00:20:50,230 --> 00:20:47,840
velocity so we're coming in at over 2

458
00:20:52,470 --> 00:20:50,240
12 000 miles per hour and we're going to

459
00:20:53,909 --> 00:20:52,480
slow down to a nice comfortable 2 miles

460
00:20:56,149 --> 00:20:53,919
per hour at landing

461
00:20:57,750 --> 00:20:56,159
and that's our deceleration

462
00:20:59,510 --> 00:20:57,760
speaking of landing you may hear a

463
00:21:01,110 --> 00:20:59,520

couple important terms

464
00:21:03,750 --> 00:21:01,120
at landing itself

465
00:21:05,510 --> 00:21:03,760
one is remu stable so the remu is a

466
00:21:07,190 --> 00:21:05,520
device on the rover that measures the

467
00:21:09,990 --> 00:21:07,200
rover's orientation and whether it's

468
00:21:12,310 --> 00:21:10,000
moving so we want a nice stable landing

469
00:21:13,909 --> 00:21:12,320
spot without any motion

470
00:21:17,430 --> 00:21:13,919
you'll also hear

471
00:21:18,230 --> 00:21:17,440
uhf stable hopefully uhf stable refers

472
00:21:19,909 --> 00:21:18,240
to

473
00:21:21,909 --> 00:21:19,919
good telecommunications link with the

474
00:21:24,230 --> 00:21:21,919
rover and indicates that we've had a

475
00:21:26,710 --> 00:21:24,240
good separation between the descent

476
00:21:29,669 --> 00:21:26,720
stage and the rover after the sky crane

477
00:21:32,390 --> 00:21:29,679
maneuver finally you may also hear tango

478
00:21:34,070 --> 00:21:32,400
delta nominal or touchdown nominal that

479
00:21:36,950 --> 00:21:34,080
means we've touched down on the surface

480
00:21:38,950 --> 00:21:36,960
of mars within the expected range of

481
00:21:41,190 --> 00:21:38,960
safe landing speeds

482
00:21:43,830 --> 00:21:41,200
thanks for that breakdown now this is

483
00:21:45,909 --> 00:21:43,840
your first mars mission what have you

484
00:21:47,909 --> 00:21:45,919
learned from this experience

485
00:21:49,190 --> 00:21:47,919
yeah one of my takeaways is that you can

486
00:21:51,110 --> 00:21:49,200
almost never be too careful when it

487
00:21:52,710 --> 00:21:51,120
comes to mars you definitely can't take

488
00:21:54,310 --> 00:21:52,720

mars for granted you know we've checked

489
00:21:57,510 --> 00:21:54,320
and double checked and triple checked

490
00:21:59,190 --> 00:21:57,520
everything on our way to mars and

491
00:22:01,909 --> 00:21:59,200
even though we've done this once before

492
00:22:04,950 --> 00:22:01,919
using the uh sky crane technique on the

493
00:22:06,870 --> 00:22:04,960
curiosity rover um you know

494
00:22:08,149 --> 00:22:06,880
i think everyone's gonna have their uh

495
00:22:09,350 --> 00:22:08,159
everyone's gonna hold their breath until

496
00:22:10,710 --> 00:22:09,360
we're on the surface of mars this time

497
00:22:12,710 --> 00:22:10,720
around

498
00:22:15,590 --> 00:22:12,720
and we have a social media question

499
00:22:18,070 --> 00:22:15,600
coming in nor the door on instagram asks

500
00:22:20,630 --> 00:22:18,080
how complicated is the automated landing

501
00:22:22,149 --> 00:22:20,640
sequence and who wrote the code

502
00:22:24,630 --> 00:22:22,159
yeah it's quite complicated uh the

503
00:22:26,789 --> 00:22:24,640
automated landing uh software needs to

504
00:22:29,110 --> 00:22:26,799
do literally hundreds of things

505
00:22:31,590 --> 00:22:29,120
all on its own just right with sub

506
00:22:32,950 --> 00:22:31,600
second timing accuracy and it's the

507
00:22:35,029 --> 00:22:32,960
result of

508
00:22:36,950 --> 00:22:35,039
many hundreds of people over many years

509
00:22:39,190 --> 00:22:36,960
stretching all the way back to curiosity

510
00:22:41,909 --> 00:22:39,200
and then improved for the perseverance

511
00:22:43,590 --> 00:22:41,919
landing today at jezreel crater

512
00:22:45,909 --> 00:22:43,600
great thanks for your time today matt

513
00:22:48,630 --> 00:22:45,919

and good luck thanks

514
00:22:50,549 --> 00:22:48,640
now landing on mars is hard

515
00:22:51,830 --> 00:22:50,559
landing on mars during a pandemic is

516
00:22:53,750 --> 00:22:51,840
even harder

517
00:22:56,230 --> 00:22:53,760
the team behind the perseverance rover

518
00:22:59,029 --> 00:22:56,240
faced one of its biggest challenges when

519
00:23:09,029 --> 00:22:59,039
the coronavirus pandemic struck here's

520
00:23:13,750 --> 00:23:11,669
when the pandemic struck

521
00:23:15,990 --> 00:23:13,760
the future was certainly unknown it was

522
00:23:17,510 --> 00:23:16,000
like walking into a blind dark alley you

523
00:23:18,950 --> 00:23:17,520
didn't know what was there what was in

524
00:23:21,669 --> 00:23:18,960
front of you what you were going to have

525
00:23:26,070 --> 00:23:23,750
it's something that nobody expected it's

526
00:23:27,830 --> 00:23:26,080
something nobody could plan for we all

527
00:23:29,750 --> 00:23:27,840
were asked to start working from home

528
00:23:31,909 --> 00:23:29,760
rather than your first priority being

529
00:23:34,070 --> 00:23:31,919
mission success and

530
00:23:36,149 --> 00:23:34,080
and getting to the launch pad your first

531
00:23:38,549 --> 00:23:36,159
priority immediately gets displaced and

532
00:23:40,230 --> 00:23:38,559
it's now the safety of the people and it

533
00:23:42,950 --> 00:23:40,240
took a lot of work to put stuff together

534
00:23:45,110 --> 00:23:42,960
in order to keep momentum going to keep

535
00:23:46,870 --> 00:23:45,120
people working safely keep them healthy

536
00:23:48,789 --> 00:23:46,880
and to keep the project

537
00:23:51,830 --> 00:23:48,799
on schedule we called the effort march

538
00:23:55,669 --> 00:23:51,840

2020 safe at work and the objective

539
00:23:57,350 --> 00:23:55,679
was to keep the team as safe or safer

540
00:23:59,430 --> 00:23:57,360
than they would be if they were not

541
00:24:01,350 --> 00:23:59,440
working you know putting a spacecraft

542
00:24:03,669 --> 00:24:01,360
together that's going to mars

543
00:24:05,190 --> 00:24:03,679
and not making a mistake it's hard no

544
00:24:06,470 --> 00:24:05,200
matter what

545
00:24:10,070 --> 00:24:06,480
trying to do it during the middle of a

546
00:24:12,149 --> 00:24:10,080
pandemic it's it's a lot harder

547
00:24:14,470 --> 00:24:12,159
at liftoff

548
00:24:16,390 --> 00:24:14,480
as the countdown to mars continues the

549
00:24:18,470 --> 00:24:16,400
perseverance of humanity launching the

550
00:24:20,149 --> 00:24:18,480
next generation of robotic explorers to

551
00:24:21,590 --> 00:24:20,159
the red planet

552
00:24:23,269 --> 00:24:21,600
certainly never done something like this

553
00:24:25,110 --> 00:24:23,279
before try to lead a team that's flying

554
00:24:27,029 --> 00:24:25,120
a spacecraft on the way to mars while

555
00:24:29,590 --> 00:24:27,039
getting ready for landing while doing it

556
00:24:31,110 --> 00:24:29,600
all from home there's no doubt that

557
00:24:32,950 --> 00:24:31,120
working

558
00:24:35,830 --> 00:24:32,960
in isolation

559
00:24:38,070 --> 00:24:35,840
not virtual isolation but in

560
00:24:39,430 --> 00:24:38,080
physical isolation from everyone else

561
00:24:41,350 --> 00:24:39,440
is a challenge

562
00:24:44,830 --> 00:24:41,360
we had to

563
00:24:49,110 --> 00:24:44,840

rethink and redesign what it meant to

564
00:24:51,269 --> 00:24:49,120
operate a spacecraft in flight when we

565
00:24:53,830 --> 00:24:51,279
couldn't all be in the same room in

566
00:24:56,470 --> 00:24:53,840
mission control seeing the data come

567
00:24:58,230 --> 00:24:56,480
down from perseverance it was a major

568
00:24:59,590 --> 00:24:58,240
change going to that you know

569
00:25:01,750 --> 00:24:59,600
looking at everyone on a screen instead

570
00:25:02,630 --> 00:25:01,760
of in person because of the pandemic you

571
00:25:04,870 --> 00:25:02,640
can't

572
00:25:06,789 --> 00:25:04,880
uh you know just pop over your cubicle

573
00:25:07,830 --> 00:25:06,799
wall and talk to the person next to you

574
00:25:09,909 --> 00:25:07,840
it's definitely been a challenge to

575
00:25:12,390 --> 00:25:09,919
figure out how to communicate and get

576
00:25:15,430 --> 00:25:12,400
everything done remotely but we've

577
00:25:19,190 --> 00:25:15,440
managed to make it work we are explorers

578
00:25:21,990 --> 00:25:19,200
our job is to go into the unknown and

579
00:25:24,070 --> 00:25:22,000
this is just another example of

580
00:25:26,710 --> 00:25:24,080
the unknown we're really

581
00:25:28,470 --> 00:25:26,720
doing something that's transformative

582
00:25:30,630 --> 00:25:28,480
and trying to understand whether or not

583
00:25:32,470 --> 00:25:30,640
life evolved on another planet that's

584
00:25:34,549 --> 00:25:32,480
the fundamental objective of this

585
00:25:35,669 --> 00:25:34,559
mission we're all still connected by

586
00:25:41,669 --> 00:25:35,679
this

587
00:25:43,990 --> 00:25:41,679
opportunity to be a part of so that

588
00:25:46,070 --> 00:25:44,000

keeps at least me going pretty much

589
00:25:48,390 --> 00:25:46,080
everybody that i've talked to that's

590
00:25:50,390 --> 00:25:48,400
associated with the mission has has said

591
00:25:52,070 --> 00:25:50,400
the same thing which is you could not

592
00:25:53,830 --> 00:25:52,080
have come up with a better name than

593
00:25:56,390 --> 00:25:53,840
perseverance

594
00:25:58,549 --> 00:25:56,400
it's an amazing serendipity we get to

595
00:25:59,970 --> 00:25:58,559
persevere through working on

596
00:26:13,700 --> 00:25:59,980
perseverance

597
00:26:13,710 --> 00:26:20,310
[Music]

598
00:26:25,590 --> 00:26:22,870
joining us now is perseverance deputy

599
00:26:29,909 --> 00:26:25,600
project manager matt wallace

600
00:26:32,789 --> 00:26:29,919
matt just how ambitious is this mission

601
00:26:35,830 --> 00:26:32,799
his team stay on track with unexpected

602
00:26:38,630 --> 00:26:35,840
challenges like the pandemic

603
00:26:41,350 --> 00:26:38,640
well it's a very ambitious mission you

604
00:26:45,190 --> 00:26:41,360
know working on a host of new

605
00:26:47,269 --> 00:26:45,200
uh extremely capable science instruments

606
00:26:50,230 --> 00:26:47,279
to do that that science mission that

607
00:26:52,470 --> 00:26:50,240
we've talked about but also a number of

608
00:26:53,510 --> 00:26:52,480
technology experiments to provide feed

609
00:26:56,310 --> 00:26:53,520
forward

610
00:26:59,430 --> 00:26:56,320
information into the next set of robotic

611
00:27:01,669 --> 00:26:59,440
explorers or even an exploration of mars

612
00:27:03,350 --> 00:27:01,679
so there's a lot for us to do we look a

613
00:27:05,510 --> 00:27:03,360

lot like curiosity but in fact we're

614
00:27:07,990 --> 00:27:05,520
carrying 50 percent more

615
00:27:10,870 --> 00:27:08,000
uh payload down to the surface of mars

616
00:27:12,870 --> 00:27:10,880
uh and so it is a it's been a big

617
00:27:14,549 --> 00:27:12,880
challenge um you know and it was

618
00:27:17,830 --> 00:27:14,559
particularly challenging when the

619
00:27:19,590 --> 00:27:17,840
endemic struck came at a critical time

620
00:27:20,789 --> 00:27:19,600
in our processing we were just months

621
00:27:22,230 --> 00:27:20,799
away

622
00:27:23,590 --> 00:27:22,240
from launching

623
00:27:25,190 --> 00:27:23,600
we're trying to

624
00:27:27,269 --> 00:27:25,200
essentially

625
00:27:28,630 --> 00:27:27,279
get the spacecraft assembled to do the

626
00:27:30,549 --> 00:27:28,640
final test

627
00:27:31,990 --> 00:27:30,559
did not have a lot of margin in our

628
00:27:34,549 --> 00:27:32,000
schedule

629
00:27:37,510 --> 00:27:34,559
our focus just entirely shifted

630
00:27:39,590 --> 00:27:37,520
from that to keeping the team safe and

631
00:27:42,149 --> 00:27:39,600
keeping their families safe

632
00:27:45,269 --> 00:27:42,159
um and we had to do that quickly to make

633
00:27:46,710 --> 00:27:45,279
the adjustment quickly uh i think

634
00:27:48,789 --> 00:27:46,720
you know we got you with a lot of help a

635
00:27:51,190 --> 00:27:48,799
lot of people stepped up to make it

636
00:27:53,269 --> 00:27:51,200
happen the team was tenacious

637
00:27:55,909 --> 00:27:53,279
uh and we managed to get it launched and

638
00:27:57,830 --> 00:27:55,919

flight to mars it's

639
00:28:00,470 --> 00:27:57,840
you know thanks to a lot of help

640
00:28:02,950 --> 00:28:00,480
and matt just how large is the team that

641
00:28:05,990 --> 00:28:02,960
worked on perseverance

642
00:28:09,029 --> 00:28:06,000
it's a big team a couple thousand people

643
00:28:10,789 --> 00:28:09,039
here just at jpl in fact have worked on

644
00:28:13,830 --> 00:28:10,799
on the mission

645
00:28:16,389 --> 00:28:13,840
and then almost every other nasa center

646
00:28:18,870 --> 00:28:16,399
has contributed in some significant

647
00:28:20,710 --> 00:28:18,880
and critical way as well

648
00:28:23,110 --> 00:28:20,720
we have um

649
00:28:25,350 --> 00:28:23,120
over a thousand industry partners that

650
00:28:26,310 --> 00:28:25,360
have provided hardware into this mission

651
00:28:29,430 --> 00:28:26,320
from

652
00:28:30,870 --> 00:28:29,440
44 different states 60 different cities

653
00:28:33,510 --> 00:28:30,880
and of course we have international

654
00:28:35,990 --> 00:28:33,520
contributions from europe and many other

655
00:28:38,470 --> 00:28:36,000
international providers as well so it's

656
00:28:40,789 --> 00:28:38,480
a it's a big team it's taken a lot of

657
00:28:42,549 --> 00:28:40,799
people to get us to where we're at

658
00:28:44,950 --> 00:28:42,559
that is a big team

659
00:28:46,789 --> 00:28:44,960
this is the most difficult landing site

660
00:28:48,950 --> 00:28:46,799
ever attempted now why do you think

661
00:28:50,950 --> 00:28:48,960
perseverance is ready to land in jezreel

662
00:28:52,789 --> 00:28:50,960
crater now

663
00:28:55,190 --> 00:28:52,799

jezreel is tough i mean it's

664
00:28:59,110 --> 00:28:55,200
scientifically fascinating because it's

665
00:29:01,990 --> 00:28:59,120
got a lot of things like craters and uh

666
00:29:04,389 --> 00:29:02,000
you know fields and cliffs and sand

667
00:29:06,630 --> 00:29:04,399
dunes and that sort of thing which are

668
00:29:08,310 --> 00:29:06,640
great for the science community that's

669
00:29:10,630 --> 00:29:08,320
the type of features they're looking for

670
00:29:13,510 --> 00:29:10,640
to learn more about mars but they're all

671
00:29:16,470 --> 00:29:13,520
anti-hazards for us uh and so

672
00:29:18,310 --> 00:29:16,480
we've had to add new technology uh to

673
00:29:20,950 --> 00:29:18,320
relevant navigation which is the ability

674
00:29:23,510 --> 00:29:20,960
essentially to divert away from hazards

675
00:29:25,590 --> 00:29:23,520
uh and but we have taken this system

676
00:29:27,430 --> 00:29:25,600
through the same types of paces that we

677
00:29:28,230 --> 00:29:27,440
have in previous missions we've used the

678
00:29:32,230 --> 00:29:28,240
same

679
00:29:35,190 --> 00:29:32,240
best practices for engineering

680
00:29:37,269 --> 00:29:35,200
verification and in many cases we've

681
00:29:39,510 --> 00:29:37,279
used the same people this in fact is my

682
00:29:40,710 --> 00:29:39,520
my fifth mars rover mission and i'm not

683
00:29:42,389 --> 00:29:40,720
alone there's other people on the

684
00:29:45,350 --> 00:29:42,399
project in the same

685
00:29:47,190 --> 00:29:45,360
in the same situation so um

686
00:29:49,269 --> 00:29:47,200
you know the team has given it

687
00:29:52,389 --> 00:29:49,279
everything they've gotten

688
00:29:53,830 --> 00:29:52,399

to put it all put it all out there and

689
00:29:54,789 --> 00:29:53,840
to make this successful and i think

690
00:29:56,470 --> 00:29:54,799
we're ready

691
00:29:59,430 --> 00:29:56,480
thanks matt and good luck on your fifth

692
00:30:01,909 --> 00:29:59,440
mission thank you very much well jezreel

693
00:30:04,389 --> 00:30:01,919
crater is a location on mars that's

694
00:30:06,230 --> 00:30:04,399
intrigued scientists for years

695
00:30:10,470 --> 00:30:06,240
let's head over to marina to learn more

696
00:30:13,430 --> 00:30:10,480
about the science goals of the mission

697
00:30:15,590 --> 00:30:13,440
that's right raquel here to explain why

698
00:30:18,549 --> 00:30:15,600
we want to go there is deputy project

699
00:30:20,389 --> 00:30:18,559
scientist katie stack morgan welcome

700
00:30:22,549 --> 00:30:20,399
katie

701
00:30:24,789 --> 00:30:22,559
thanks marina glad to be here now

702
00:30:27,510 --> 00:30:24,799
perseverance is landing on mars at the

703
00:30:31,110 --> 00:30:27,520
jezreel crater why is it that you and

704
00:30:33,110 --> 00:30:31,120
the team chose this particular area

705
00:30:35,350 --> 00:30:33,120
yeah so scientists believe jezreel

706
00:30:37,909 --> 00:30:35,360
crater is one of the best places on mars

707
00:30:40,230 --> 00:30:37,919
and possibly the entire solar system to

708
00:30:42,630 --> 00:30:40,240
look for friends of ancient life israel

709
00:30:44,310 --> 00:30:42,640
contained an ancient lake and has within

710
00:30:46,870 --> 00:30:44,320
it one of the best preserved ancient

711
00:30:49,269 --> 00:30:46,880
delta deposits in the on the surface of

712
00:30:51,430 --> 00:30:49,279
mars and deltas form when a river enters

713
00:30:53,909 --> 00:30:51,440

a relatively open body of water like an

714
00:30:56,070 --> 00:30:53,919
impact crater and deposits the sediment

715
00:30:57,909 --> 00:30:56,080
that it's carrying into the lake and we

716
00:30:59,269 --> 00:30:57,919
know based on studies of deltas and

717
00:31:01,350 --> 00:30:59,279
lakes here on earth that they're great

718
00:31:03,590 --> 00:31:01,360
places to concentrate and preserve

719
00:31:05,909 --> 00:31:03,600
organics and support microbial life

720
00:31:09,110 --> 00:31:05,919
we're also excited because gyro

721
00:31:10,549 --> 00:31:09,120
exposes rocks that um are between three

722
00:31:12,149 --> 00:31:10,559
and a half to more than four billion

723
00:31:14,950 --> 00:31:12,159
years old and represent a variety of

724
00:31:16,870 --> 00:31:14,960
different geological processes

725
00:31:18,310 --> 00:31:16,880
now this might be a tough choice but

726
00:31:20,789 --> 00:31:18,320
what do you think would be the most

727
00:31:23,909 --> 00:31:20,799
rewarding scientific discovery that we

728
00:31:25,990 --> 00:31:23,919
expect to get from this mission

729
00:31:27,830 --> 00:31:26,000
it's hands down i think the most

730
00:31:29,430 --> 00:31:27,840
rewarding discovery i think we can make

731
00:31:31,990 --> 00:31:29,440
with perseverance would be finding a

732
00:31:34,230 --> 00:31:32,000
truly compelling ancient bio signature

733
00:31:36,070 --> 00:31:34,240
on mars the rocks in and around jezreel

734
00:31:38,070 --> 00:31:36,080
crater record a period of time when life

735
00:31:39,830 --> 00:31:38,080
first arose in the solar system and we

736
00:31:41,830 --> 00:31:39,840
have the opportunity with perseverance

737
00:31:43,669 --> 00:31:41,840
to study the evolution of the planet

738
00:31:45,669 --> 00:31:43,679

from a once habitable world likely

739
00:31:47,669 --> 00:31:45,679
capable of supporting ancient life to

740
00:31:49,590 --> 00:31:47,679
the cold barren planet we know mars is

741
00:31:51,509 --> 00:31:49,600
today

742
00:31:54,310 --> 00:31:51,519
and why do you think katie it's so

743
00:31:57,990 --> 00:31:54,320
important to find out if there really is

744
00:31:59,269 --> 00:31:58,000
or was ancient life on mars

745
00:32:01,110 --> 00:31:59,279
well the question of whether there's

746
00:32:03,110 --> 00:32:01,120
life beyond earth is one of the most

747
00:32:05,590 --> 00:32:03,120
fundamental and essential questions we

748
00:32:07,269 --> 00:32:05,600
can ask and our ability to ask this

749
00:32:09,590 --> 00:32:07,279
question and develop the scientific

750
00:32:11,830 --> 00:32:09,600
investigations and technology to answer

751
00:32:13,990 --> 00:32:11,840
it is one of the things that make us as

752
00:32:15,669 --> 00:32:14,000
a species so unique and based on

753
00:32:17,590 --> 00:32:15,679
everything we know about mars in the

754
00:32:19,750 --> 00:32:17,600
past it absolutely should have been

755
00:32:21,750 --> 00:32:19,760
capable of supporting each life so we

756
00:32:23,430 --> 00:32:21,760
can find out an answer to the question

757
00:32:25,669 --> 00:32:23,440
where there were habitable environments

758
00:32:27,669 --> 00:32:25,679
was there life and studying the possible

759
00:32:29,110 --> 00:32:27,679
emergence of life on ancient mars can

760
00:32:30,789 --> 00:32:29,120
also help us better understand the

761
00:32:33,029 --> 00:32:30,799
conditions that led to life on our own

762
00:32:35,029 --> 00:32:33,039
planet

763
00:32:37,590 --> 00:32:35,039

that's so fascinating katie now we're

764
00:32:39,990 --> 00:32:37,600
going to take a question from a student

765
00:32:43,590 --> 00:32:40,000
vara

766
00:32:46,630 --> 00:32:43,600
hi i'm laura and my question is

767
00:32:49,750 --> 00:32:46,640
why was mars able to sustain lakes and

768
00:32:51,750 --> 00:32:49,760
rivers apes ago but cannot now

769
00:32:53,269 --> 00:32:51,760
isn't it old enough to make water and

770
00:32:56,470 --> 00:32:53,279
isn't it always

771
00:32:58,870 --> 00:32:56,480
thank you

772
00:33:00,870 --> 00:32:58,880
yeah that is such a great question um

773
00:33:02,710 --> 00:33:00,880
and one of the things that protects our

774
00:33:04,549 --> 00:33:02,720
atmosphere here on earth and allows

775
00:33:06,070 --> 00:33:04,559
liquid water to be stable on our own

776
00:33:07,509 --> 00:33:06,080
planet is the fact that we have a

777
00:33:09,909 --> 00:33:07,519
magnetic field protecting that

778
00:33:11,990 --> 00:33:09,919
atmosphere we think that mars lost its

779
00:33:14,389 --> 00:33:12,000
magnetic field way back europe billions

780
00:33:16,950 --> 00:33:14,399
of years ago and left the atmosphere

781
00:33:18,789 --> 00:33:16,960
exposed to things like solar and cosmic

782
00:33:21,269 --> 00:33:18,799
rays that basically blew that atmosphere

783
00:33:22,870 --> 00:33:21,279
away and once that happened liquid water

784
00:33:24,470 --> 00:33:22,880
wasn't stable on the surface of mars

785
00:33:27,110 --> 00:33:24,480
anymore it was too cold and there and

786
00:33:28,630 --> 00:33:27,120
the pressure was too low and so now mars

787
00:33:30,070 --> 00:33:28,640
is not capable of supporting liquid

788
00:33:32,549 --> 00:33:30,080

water and likely not capable of

789
00:33:34,230 --> 00:33:32,559
supporting life at its surface

790
00:33:35,830 --> 00:33:34,240
well thank you so much to vara for that

791
00:33:37,830 --> 00:33:35,840
great question and a big shout out to

792
00:33:40,310 --> 00:33:37,840
all the kids that are watching out there

793
00:33:43,509 --> 00:33:40,320
today and thank you so much to you katie

794
00:33:44,470 --> 00:33:43,519
for joining us that was so great

795
00:33:47,430 --> 00:33:44,480
thank you

796
00:33:49,590 --> 00:33:47,440
now sending it back over to you raquel

797
00:33:51,830 --> 00:33:49,600
thanks marina earlier we were able to

798
00:33:54,870 --> 00:33:51,840
catch up with the communication systems

799
00:33:56,549 --> 00:33:54,880
engineer chloe sakir she helps us break

800
00:33:59,990 --> 00:33:56,559
down the system used to track

801
00:34:01,909 --> 00:34:00,000
perseverance during landing

802
00:34:03,990 --> 00:34:01,919
the communications infrastructure

803
00:34:06,630 --> 00:34:04,000
supporting perseverance's landing is

804
00:34:08,389 --> 00:34:06,640
quite complex we've rallied a truly

805
00:34:11,109 --> 00:34:08,399
global network of relay and

806
00:34:13,190 --> 00:34:11,119
communications assets to help us capture

807
00:34:15,909 --> 00:34:13,200
and record those precious minutes of

808
00:34:17,750 --> 00:34:15,919
entry descent and landing or edl

809
00:34:20,149 --> 00:34:17,760
we receive a stream of engineering

810
00:34:22,790 --> 00:34:20,159
telemetry via these communication assets

811
00:34:24,710 --> 00:34:22,800
that helps us see and understand exactly

812
00:34:27,270 --> 00:34:24,720
what's happening perseverance sends

813
00:34:29,270 --> 00:34:27,280

direct to earth x-band tones each of

814
00:34:30,790 --> 00:34:29,280
which provides us with indications of

815
00:34:32,950 --> 00:34:30,800
critical entry descent and landing

816
00:34:35,430 --> 00:34:32,960
events during entry descent and landing

817
00:34:38,310 --> 00:34:35,440
we have two mars orbiters listening for

818
00:34:40,710 --> 00:34:38,320
the ultra high frequency or uhf signals

819
00:34:42,629 --> 00:34:40,720
from perseverance these orbiters relay

820
00:34:45,270 --> 00:34:42,639
these signals to deep space network

821
00:34:47,669 --> 00:34:45,280
stations on earth madrid in spain and

822
00:34:50,310 --> 00:34:47,679
goldstone in california the mars

823
00:34:52,550 --> 00:34:50,320
reconnaissance orbiter or mro has

824
00:34:54,790 --> 00:34:52,560
reconfigured its software to perform a

825
00:34:57,109 --> 00:34:54,800
type of relay called bent pipe this will

826
00:34:59,349 --> 00:34:57,119
provide us with near real-time telemetry

827
00:35:01,030 --> 00:34:59,359
during entry descent and landing we have

828
00:35:03,510 --> 00:35:01,040
coverage from the mars reconnaissance

829
00:35:05,829 --> 00:35:03,520
orbiter from just before entry to a few

830
00:35:07,910 --> 00:35:05,839
minutes after landing the telemetry we

831
00:35:10,550 --> 00:35:07,920
receive will be delayed by the time it

832
00:35:12,950 --> 00:35:10,560
takes light to travel from mars to us

833
00:35:14,710 --> 00:35:12,960
back on earth additionally the mars

834
00:35:17,190 --> 00:35:14,720
atmosphere and volatile evolution

835
00:35:19,589 --> 00:35:17,200
spacecraft or maven is recording these

836
00:35:22,310 --> 00:35:19,599
uhf signals and will be relaying that

837
00:35:24,150 --> 00:35:22,320
recording hours after landing maven will

838
00:35:26,310 --> 00:35:24,160

be covering us from around the time of

839
00:35:28,150 --> 00:35:26,320
cruise stage separation until a few

840
00:35:30,230 --> 00:35:28,160
minutes after landing

841
00:35:32,150 --> 00:35:30,240
we also receive what we call heartbeat

842
00:35:34,150 --> 00:35:32,160
tones which are indications that the

843
00:35:36,230 --> 00:35:34,160
spacecraft is alive and progressing

844
00:35:38,150 --> 00:35:36,240
throughout entry descent and landing

845
00:35:40,069 --> 00:35:38,160
it's important to note that while

846
00:35:41,990 --> 00:35:40,079
unexpected we could lose our

847
00:35:44,310 --> 00:35:42,000
communication lengths and still land

848
00:35:45,910 --> 00:35:44,320
safely because perseverance is doing

849
00:35:47,910 --> 00:35:45,920
entry descent and landing completely

850
00:35:49,430 --> 00:35:47,920
autonomously she doesn't need our help

851
00:35:51,190 --> 00:35:49,440
to joystick the landing the

852
00:35:53,990 --> 00:35:51,200
communication links give us added

853
00:35:58,870 --> 00:35:56,069
and you can see chloe hard at work

854
00:36:01,030 --> 00:35:58,880
inside mission control right now

855
00:36:03,510 --> 00:36:01,040
perseverance's landing might look like

856
00:36:05,270 --> 00:36:03,520
the system the curiosity rover used back

857
00:36:08,310 --> 00:36:05,280
in 2012

858
00:36:10,470 --> 00:36:08,320
but landing on mars is difficult there's

859
00:36:12,230 --> 00:36:10,480
always a risk involved

860
00:36:14,630 --> 00:36:12,240
here's what needs to happen for

861
00:36:17,030 --> 00:36:14,640
perseverance to touch down safely in

862
00:36:18,310 --> 00:36:17,040
jezreel crater

863
00:36:19,670 --> 00:36:18,320

nothing can be taken for granted when

864
00:36:22,230 --> 00:36:19,680
you get to mars there's a lot of things

865
00:36:24,069 --> 00:36:22,240
we just don't know space always has a

866
00:36:26,069 --> 00:36:24,079
way of throwing us curveballs and

867
00:36:27,430 --> 00:36:26,079
surprising us i mean until we get the

868
00:36:29,270 --> 00:36:27,440
data that says we're on the ground

869
00:36:32,100 --> 00:36:29,280
safely i'm gonna be worried that we're

870
00:36:35,430 --> 00:36:33,349
[Music]

871
00:36:37,349 --> 00:36:35,440
entry descent and landing is often

872
00:36:38,550 --> 00:36:37,359
referred to as the seven minutes of

873
00:36:40,710 --> 00:36:38,560
terror

874
00:36:43,270 --> 00:36:40,720
because it takes about seven minutes to

875
00:36:47,030 --> 00:36:43,280
get from the top of the atmosphere of

876
00:36:49,589 --> 00:36:47,040
mars to the ground safely the spacecraft

877
00:36:50,470 --> 00:36:49,599
has to do all of this by itself there

878
00:36:53,270 --> 00:36:50,480
are

879
00:36:55,510 --> 00:36:53,280
many things that have to go right to get

880
00:36:56,790 --> 00:36:55,520
perseverance onto the ground safely

881
00:36:58,630 --> 00:36:56,800
there's a lot counting on this this is

882
00:37:01,670 --> 00:36:58,640
the first leg of our sample return relay

883
00:37:03,589 --> 00:37:01,680
race there's a lot of work on the line

884
00:37:06,069 --> 00:37:03,599
starting about 10 minutes before

885
00:37:08,069 --> 00:37:06,079
atmospheric entry we get rid of really

886
00:37:10,310 --> 00:37:08,079
the spacecraft part of of the rover

887
00:37:12,950 --> 00:37:10,320
that's been supporting us we come

888
00:37:16,470 --> 00:37:12,960

screaming in to the martian atmosphere

889
00:37:18,950 --> 00:37:16,480
at 12 to 13 000 miles per hour

890
00:37:21,349 --> 00:37:18,960
and the heat shield is what dissipates

891
00:37:22,630 --> 00:37:21,359
all that initial energy through friction

892
00:37:24,069 --> 00:37:22,640
the vehicle will continue actually

893
00:37:25,750 --> 00:37:24,079
flying itself through the atmosphere

894
00:37:26,870 --> 00:37:25,760
it's sort of like a transforming vehicle

895
00:37:28,390 --> 00:37:26,880
that went from spacecraft and now it's

896
00:37:30,069 --> 00:37:28,400
kind of like an aircraft actively

897
00:37:34,630 --> 00:37:30,079
guiding itself when we're going slow

898
00:37:38,470 --> 00:37:36,310
the biggest supersonic parachute we've

899
00:37:41,270 --> 00:37:38,480
ever sent to another planet it's

900
00:37:43,589 --> 00:37:41,280
critical for slowing down the vehicle

901
00:37:47,109 --> 00:37:43,599
perseverances entry descent and landing

902
00:37:49,190 --> 00:37:47,119
borrows heavily from that of curiosity

903
00:37:51,750 --> 00:37:49,200
but fundamentally perseverance is a

904
00:37:53,589 --> 00:37:51,760
different rover she's bigger she has

905
00:37:55,430 --> 00:37:53,599
different instruments we've added a lot

906
00:37:57,030 --> 00:37:55,440
of smarts on the inside to make it more

907
00:37:58,550 --> 00:37:57,040
capable so that it can deal with the

908
00:38:00,550 --> 00:37:58,560
landing site that we've given the

909
00:38:02,710 --> 00:38:00,560
science team identified jezreel crater

910
00:38:05,030 --> 00:38:02,720
as basically an ancient lake bed and one

911
00:38:06,790 --> 00:38:05,040
of the most promising places to look for

912
00:38:08,710 --> 00:38:06,800
evidence of ancient microbial life and

913
00:38:11,030 --> 00:38:08,720

to collect samples for future return to

914
00:38:13,430 --> 00:38:11,040
earth uh the problem is it's a much more

915
00:38:15,750 --> 00:38:13,440
hazardous place to land when you look at

916
00:38:17,510 --> 00:38:15,760
jezreel all you see is danger how do we

917
00:38:19,510 --> 00:38:17,520
go to a site that we never thought was

918
00:38:20,790 --> 00:38:19,520
safe enough to go to before

919
00:38:21,910 --> 00:38:20,800
so the heat shield which has protected

920
00:38:23,589 --> 00:38:21,920
us all the way through entry is no

921
00:38:25,430 --> 00:38:23,599
longer necessary we need to get that off

922
00:38:26,630 --> 00:38:25,440
so that we can actually see the ground

923
00:38:29,030 --> 00:38:26,640
and we can see the ground in a couple

924
00:38:30,950 --> 00:38:29,040
different ways perseverance will be the

925
00:38:33,670 --> 00:38:30,960
first mission to use terrain relative

926
00:38:35,910 --> 00:38:33,680
navigation so while it's descending on

927
00:38:38,710 --> 00:38:35,920
the parachute it will actually be taking

928
00:38:40,950 --> 00:38:38,720
images of the surface of mars and

929
00:38:43,430 --> 00:38:40,960
determining where to go based on what it

930
00:38:44,950 --> 00:38:43,440
sees this is finally like landing with

931
00:38:47,349 --> 00:38:44,960
your eyes open

932
00:38:49,990 --> 00:38:47,359
having this new technology really allows

933
00:38:52,790 --> 00:38:50,000
perseverance to land in much more

934
00:38:55,430 --> 00:38:52,800
challenging terrain than curiosity or

935
00:38:57,990 --> 00:38:55,440
any previous mars mission could amongst

936
00:38:59,109 --> 00:38:58,000
the rocks and the craters and the cliffs

937
00:39:00,390 --> 00:38:59,119
these things are

938
00:39:02,950 --> 00:39:00,400

hazardous to

939
00:39:05,190 --> 00:39:02,960
the rover but these are the things that

940
00:39:06,790 --> 00:39:05,200
are interesting to the scientists

941
00:39:08,870 --> 00:39:06,800
once perseverance has figured out where

942
00:39:10,470 --> 00:39:08,880
she is get us in the back shell and

943
00:39:14,069 --> 00:39:10,480
parachute

944
00:39:15,990 --> 00:39:14,079
and light up our rockets

945
00:39:17,589 --> 00:39:16,000
rockets help us dear to a safe landing

946
00:39:19,589 --> 00:39:17,599
spot that's nearby

947
00:39:22,069 --> 00:39:19,599
that descent stage takes us all the way

948
00:39:28,069 --> 00:39:22,079
down to about 20 meters off the ground

949
00:39:31,910 --> 00:39:30,230
the rover has hit the ground the descent

950
00:39:34,150 --> 00:39:31,920
stage will cut loose from the rover and

951
00:39:36,310 --> 00:39:34,160
fly away to a safe distance

952
00:39:38,630 --> 00:39:36,320
surviving that seven minutes is really

953
00:39:40,310 --> 00:39:38,640
just the beginning for perseverance its

954
00:39:42,069 --> 00:39:40,320
job right being the first leg of sample

955
00:39:44,470 --> 00:39:42,079
return to go look for those signs of

956
00:39:46,470 --> 00:39:44,480
past life on mars all that can't start

957
00:39:48,390 --> 00:39:46,480
until we get perseverance safely to the

958
00:40:00,720 --> 00:39:48,400
ground and then that's when the real

959
00:40:15,670 --> 00:40:08,910
[Music]

960
00:40:20,790 --> 00:40:18,309
with us now is al chen he is

961
00:40:21,829 --> 00:40:20,800
perseverance's entry descent and landing

962
00:40:23,910 --> 00:40:21,839
lead

963
00:40:26,150 --> 00:40:23,920

al you were part of the curiosity rover

964
00:40:27,750 --> 00:40:26,160
landing does it get any easier the

965
00:40:29,430 --> 00:40:27,760
second time around

966
00:40:30,950 --> 00:40:29,440
it absolutely does not especially when

967
00:40:33,430 --> 00:40:30,960
considering we're trying to land the

968
00:40:35,270 --> 00:40:33,440
biggest heaviest and most complex rover

969
00:40:37,270 --> 00:40:35,280
we've ever built at the most dangerous

970
00:40:38,950 --> 00:40:37,280
landing site we've ever attempted

971
00:40:40,630 --> 00:40:38,960
jezreel may look great and you know

972
00:40:42,870 --> 00:40:40,640
promising from a science perspective but

973
00:40:44,790 --> 00:40:42,880
it's absolutely treacherous for landing

974
00:40:46,390 --> 00:40:44,800
there's a cliff cliff wall that's about

975
00:40:47,990 --> 00:40:46,400
200 feet tall that runs right through

976
00:40:49,430 --> 00:40:48,000
the middle of landing site there are

977
00:40:50,710 --> 00:40:49,440
craters full of sand that even if we

978
00:40:52,630 --> 00:40:50,720
landed them we would not be able to

979
00:40:54,550 --> 00:40:52,640
drive out of and there are rocks to the

980
00:40:56,710 --> 00:40:54,560
east and actually all over the place

981
00:40:59,030 --> 00:40:56,720
rock fields that would be a bad day for

982
00:41:02,230 --> 00:40:59,040
us if we were to land on them

983
00:41:04,710 --> 00:41:02,240
now al what new technology makes this

984
00:41:05,990 --> 00:41:04,720
type of land dangerous landing possible

985
00:41:07,430 --> 00:41:06,000
perseverance is carrying two new

986
00:41:09,430 --> 00:41:07,440
technologies that are really kind of

987
00:41:11,510 --> 00:41:09,440
under the hood smarts that are allowing

988
00:41:12,309 --> 00:41:11,520

us to end at this treacherous landing

989
00:41:14,150 --> 00:41:12,319
site

990
00:41:15,510 --> 00:41:14,160
the first is range trigger that's the

991
00:41:17,589 --> 00:41:15,520
ability we've given perseverance the

992
00:41:19,270 --> 00:41:17,599
ability to decide for herself based on

993
00:41:21,270 --> 00:41:19,280
where she is when to deploy the

994
00:41:23,109 --> 00:41:21,280
parachute previously we used to deploy

995
00:41:25,589 --> 00:41:23,119
parachutes that supersonic parachute

996
00:41:27,030 --> 00:41:25,599
based just on navigated velocity but now

997
00:41:28,790 --> 00:41:27,040
perseverance has the smarts to figure

998
00:41:30,309 --> 00:41:28,800
out where she is and deploy that

999
00:41:31,829 --> 00:41:30,319
parachute at just the right place to

1000
00:41:34,470 --> 00:41:31,839
make sure that we shrink where we could

1001
00:41:36,470 --> 00:41:34,480
come down that actually reduces the area

1002
00:41:37,910 --> 00:41:36,480
that error ellipse where we can come

1003
00:41:39,349 --> 00:41:37,920
down on the ground

1004
00:41:41,430 --> 00:41:39,359
from something that was on the order of

1005
00:41:44,230 --> 00:41:41,440
15 miles long by 12 miles wide for

1006
00:41:45,430 --> 00:41:44,240
curiosity to about 5 miles long by 4

1007
00:41:46,870 --> 00:41:45,440
miles wide

1008
00:41:48,550 --> 00:41:46,880
for perseverance so that's quite a bit

1009
00:41:50,390 --> 00:41:48,560
of reduction

1010
00:41:51,910 --> 00:41:50,400
second the next piece of technology

1011
00:41:53,349 --> 00:41:51,920
that's helping us land there is train

1012
00:41:54,950 --> 00:41:53,359
relative navigation

1013
00:41:56,710 --> 00:41:54,960

um in the past after we've popped off

1014
00:41:58,150 --> 00:41:56,720
the heat shield we've taken pictures of

1015
00:42:00,230 --> 00:41:58,160
the ground as it's been coming up but we

1016
00:42:02,069 --> 00:42:00,240
haven't really done anything with them

1017
00:42:03,990 --> 00:42:02,079
this time perseverance is carrying a

1018
00:42:06,150 --> 00:42:04,000
camera to take pictures but also a kind

1019
00:42:07,750 --> 00:42:06,160
of second brain to help that figure out

1020
00:42:09,670 --> 00:42:07,760
what those pictures are telling it and

1021
00:42:11,670 --> 00:42:09,680
match it up with an onboard map from a

1022
00:42:13,430 --> 00:42:11,680
satellite uh that allows it to figure

1023
00:42:15,109 --> 00:42:13,440
out exactly where she is

1024
00:42:16,950 --> 00:42:15,119
suddenly then she can she can then fly

1025
00:42:18,870 --> 00:42:16,960
to safe spots that are nearby when she

1026
00:42:20,710 --> 00:42:18,880
really knows where she is it allows the

1027
00:42:22,150 --> 00:42:20,720
site to not have to be as flat and

1028
00:42:23,910 --> 00:42:22,160
boring as a pancake as if some of our

1029
00:42:25,829 --> 00:42:23,920
past sites had been the entire area we

1030
00:42:27,990 --> 00:42:25,839
could come down now we just need little

1031
00:42:29,109 --> 00:42:28,000
pieces of that site to be small enough

1032
00:42:31,430 --> 00:42:29,119
and safe enough

1033
00:42:32,790 --> 00:42:31,440
for us to land in safely and fly there

1034
00:42:34,470 --> 00:42:32,800
after we've just after we've gotten rid

1035
00:42:36,630 --> 00:42:34,480
of the parachute

1036
00:42:39,910 --> 00:42:36,640
and we also have a social media question

1037
00:42:40,950 --> 00:42:39,920
coming in sansacari14 on instagram is

1038
00:42:42,950 --> 00:42:40,960

asking

1039
00:42:45,829 --> 00:42:42,960
how does the sky crane decide where to

1040
00:42:47,430 --> 00:42:45,839
move itself after the payload lands

1041
00:42:49,510 --> 00:42:47,440
after the payload lands after the rover

1042
00:42:50,790 --> 00:42:49,520
touches down uh the the sky crane the

1043
00:42:52,950 --> 00:42:50,800
descent stage which is that rocket

1044
00:42:54,470 --> 00:42:52,960
powered jet pack above it the first stop

1045
00:42:56,470 --> 00:42:54,480
of course is to make sure you don't hurt

1046
00:42:57,829 --> 00:42:56,480
the rover so it'll turn forward or

1047
00:42:59,589 --> 00:42:57,839
backward

1048
00:43:01,589 --> 00:42:59,599
so that the engine plumes don't pass

1049
00:43:03,430 --> 00:43:01,599
over the rover so it'll come up and

1050
00:43:05,670 --> 00:43:03,440
start to turn and it'll go in whichever

1051
00:43:07,030 --> 00:43:05,680
direction is closest to north so it can

1052
00:43:08,630 --> 00:43:07,040
either go forward if that's the way

1053
00:43:10,710 --> 00:43:08,640
north is or go toward the rear of the

1054
00:43:13,990 --> 00:43:10,720
rover if that's where north is and it'll

1055
00:43:16,309 --> 00:43:14,000
fly about a third of a mile or so away

1056
00:43:17,430 --> 00:43:16,319
thanks for talking to us today al thank

1057
00:43:19,750 --> 00:43:17,440
you very much

1058
00:43:24,309 --> 00:43:19,760
now let's head back to mission control

1059
00:43:29,829 --> 00:43:27,109
hi raquel so remember that command that

1060
00:43:31,190 --> 00:43:29,839
we sent at around 11 35 to turn the

1061
00:43:34,470 --> 00:43:31,200
transmitter off

1062
00:43:35,510 --> 00:43:34,480
we are just about to get confirmation

1063
00:43:38,950 --> 00:43:35,520

that

1064
00:43:40,790 --> 00:43:38,960
perseverance has received the command

1065
00:43:43,589 --> 00:43:40,800
the command took 11 minutes to go to

1066
00:43:46,710 --> 00:43:43,599
perseverance and then the reply took 11

1067
00:43:49,349 --> 00:43:46,720
minutes to get back from perseverance to

1068
00:43:51,750 --> 00:43:49,359
the ground so we should hear

1069
00:43:53,190 --> 00:43:51,760
any second now that

1070
00:43:55,510 --> 00:43:53,200
we have officially turned off the

1071
00:43:56,710 --> 00:43:55,520
transmitter and after that we will be

1072
00:43:59,589 --> 00:43:56,720
about

1073
00:44:01,510 --> 00:43:59,599
four minutes from the start of entry

1074
00:44:03,910 --> 00:44:01,520
descent and landing mode at this point

1075
00:44:05,670 --> 00:44:03,920
we will transition from the cruise

1076
00:44:09,109 --> 00:44:05,680
approach mode to entry descent and

1077
00:44:11,510 --> 00:44:09,119
landing and that means our travel from

1078
00:44:13,990 --> 00:44:11,520
earth to mars is done and now we just

1079
00:44:16,870 --> 00:44:14,000
need to get to the surface

1080
00:44:25,740 --> 00:44:16,880
so far things are looking good

1081
00:44:45,829 --> 00:44:28,550
[Music]

1082
00:44:49,190 --> 00:44:47,349
our tracking stations have all confirmed

1083
00:44:51,589 --> 00:44:49,200
the results of the transmitter drive off

1084
00:44:54,069 --> 00:44:51,599
and in lock one way

1085
00:44:55,990 --> 00:44:54,079
copy ace

1086
00:44:58,230 --> 00:44:56,000
gds flight

1087
00:45:01,430 --> 00:44:58,240
flight gtf at this time i'd like to

1088
00:45:03,510 --> 00:45:01,440

disable the alarms before edl main

1089
00:45:06,069 --> 00:45:03,520
so please disable all the alarm files

1090
00:45:08,150 --> 00:45:06,079
and start a new downlink session

1091
00:45:13,670 --> 00:45:08,160
we'll talk about ecp

1092
00:45:21,750 --> 00:45:15,349
we are now officially one way and the

1093
00:45:26,630 --> 00:45:25,109
rover mission has helped shape the other

1094
00:45:30,150 --> 00:45:26,640
started with the landing of the

1095
00:45:31,510 --> 00:45:30,160
pathfinder more than 20 years ago

1096
00:45:32,950 --> 00:45:31,520
leading up to where we are today with

1097
00:45:37,670 --> 00:45:32,960
perseverance

1098
00:45:41,990 --> 00:45:37,680
jennifer trosper has worked on every

1099
00:45:44,710 --> 00:45:42,000
mars rover mission and she joins us now

1100
00:45:47,829 --> 00:45:44,720
uh jennifer how does perseverance fit

1101
00:45:50,550 --> 00:45:47,839
into the history of exploring mars

1102
00:45:53,510 --> 00:45:50,560
thanks raquel it's great to be here well

1103
00:45:55,190 --> 00:45:53,520
perseverance is nasa's fifth rover on

1104
00:45:57,510 --> 00:45:55,200
mars and i've had the privilege of

1105
00:45:59,670 --> 00:45:57,520
working on every one of them and the

1106
00:46:02,790 --> 00:45:59,680
very first rover was the sojourner rover

1107
00:46:06,150 --> 00:46:02,800
we sent in 1997 and it was the size of a

1108
00:46:08,950 --> 00:46:06,160
microwave oven and even at that small

1109
00:46:11,349 --> 00:46:08,960
size sojourner was able to transform the

1110
00:46:14,710 --> 00:46:11,359
way that we explore mars from

1111
00:46:16,950 --> 00:46:14,720
stationary landers to small roving

1112
00:46:19,910 --> 00:46:16,960
robots that go from place to place just

1113
00:46:22,230 --> 00:46:19,920

like a geologist would on earth so once

1114
00:46:24,630 --> 00:46:22,240
we had that roving capability

1115
00:46:25,829 --> 00:46:24,640
then we sent our twin rovers spirit and

1116
00:46:31,030 --> 00:46:25,839
opportunity

1117
00:46:32,230 --> 00:46:31,040
finding evidence of ancient water on

1118
00:46:34,309 --> 00:46:32,240
mars

1119
00:46:36,550 --> 00:46:34,319
now they did they're great explorers and

1120
00:46:39,030 --> 00:46:36,560
both of them found ample evidence that

1121
00:46:39,990 --> 00:46:39,040
water had once existed on the surface of

1122
00:46:41,910 --> 00:46:40,000
mars

1123
00:46:45,270 --> 00:46:41,920
but we had a question another question

1124
00:46:47,109 --> 00:46:45,280
then was mars ever habitable if water

1125
00:46:49,589 --> 00:46:47,119
had been there and that's when we sent

1126
00:46:52,390 --> 00:46:49,599
curiosity now curiosity was a major

1127
00:46:55,270 --> 00:46:52,400
upgrade to our rover fleet she's the

1128
00:46:58,309 --> 00:46:55,280
size of a small car she landed with the

1129
00:47:00,309 --> 00:46:58,319
sky crane system instead of airbags and

1130
00:47:02,790 --> 00:47:00,319
she also carries along her own sample

1131
00:47:03,750 --> 00:47:02,800
analytics lab and she's still operating

1132
00:47:06,309 --> 00:47:03,760
today

1133
00:47:08,630 --> 00:47:06,319
and during her exploration she has found

1134
00:47:11,109 --> 00:47:08,640
evidence of a habitable environment in

1135
00:47:13,270 --> 00:47:11,119
an ancient lake bed on mars

1136
00:47:15,349 --> 00:47:13,280
so now we're sending perseverance

1137
00:47:17,589 --> 00:47:15,359
perseverance is tasked

1138
00:47:20,549 --> 00:47:17,599

with answering the question and looking

1139
00:47:23,190 --> 00:47:20,559
for evidence of ancient microbial life

1140
00:47:25,030 --> 00:47:23,200
on mars and in order to do this she has

1141
00:47:27,190 --> 00:47:25,040
to be the smartest and most capable

1142
00:47:29,030 --> 00:47:27,200
rover we've ever sent

1143
00:47:31,430 --> 00:47:29,040
speaking of perseverance can you tell us

1144
00:47:34,150 --> 00:47:31,440
more about how perseverance is smarter

1145
00:47:36,710 --> 00:47:34,160
than its predecessors yes we've made a

1146
00:47:39,270 --> 00:47:36,720
lot of upgrades to help her along with

1147
00:47:41,990 --> 00:47:39,280
the surface mission one of them is for

1148
00:47:44,150 --> 00:47:42,000
her autonomous traverse capability when

1149
00:47:46,390 --> 00:47:44,160
i say autonomous traverse i mean we tell

1150
00:47:48,790 --> 00:47:46,400
her where we want her to end up and she

1151
00:47:50,870 --> 00:47:48,800
has to figure out the safe and best way

1152
00:47:53,829 --> 00:47:50,880
to get there in order to do that she

1153
00:47:55,510 --> 00:47:53,839
uses her cameras algorithms a computer

1154
00:47:57,349 --> 00:47:55,520
so we've given her another computer

1155
00:47:59,829 --> 00:47:57,359
we've upgraded the cameras and we've

1156
00:48:02,230 --> 00:47:59,839
upgraded the algorithms now she drives

1157
00:48:05,030 --> 00:48:02,240
three times as fast as curiosity could

1158
00:48:07,109 --> 00:48:05,040
drive in this autonomous traverse mode

1159
00:48:09,829 --> 00:48:07,119
in fact her average

1160
00:48:12,309 --> 00:48:09,839
daily distance for driving about 200

1161
00:48:14,390 --> 00:48:12,319
meters is close to the maximum distance

1162
00:48:16,309 --> 00:48:14,400
any rover has ever driven in a day on

1163
00:48:17,829 --> 00:48:16,319

mars so she's fast

1164
00:48:20,150 --> 00:48:17,839
another thing that we've done which is

1165
00:48:23,990 --> 00:48:20,160
the most significant upgrade that we've

1166
00:48:26,069 --> 00:48:24,000
made is the sample caching system itself

1167
00:48:28,150 --> 00:48:26,079
curiosity has a robotic arm like

1168
00:48:30,950 --> 00:48:28,160
perseverance has a robotic arm but on

1169
00:48:33,349 --> 00:48:30,960
the end of perseverance's robotic arm is

1170
00:48:34,790 --> 00:48:33,359
a coring drill that will go and take

1171
00:48:36,950 --> 00:48:34,800
rock cores

1172
00:48:39,670 --> 00:48:36,960
transfer them into sample tubes and into

1173
00:48:42,390 --> 00:48:39,680
the rover where another robotic arm will

1174
00:48:44,710 --> 00:48:42,400
take those tubes will seal them and

1175
00:48:46,790 --> 00:48:44,720
store them and eventually drop them on

1176
00:48:48,309 --> 00:48:46,800
the surface of mars for future return to

1177
00:48:50,390 --> 00:48:48,319
earth

1178
00:48:53,030 --> 00:48:50,400
great and we also have a social media

1179
00:48:55,829 --> 00:48:53,040
question about perseverance erica a s on

1180
00:48:57,990 --> 00:48:55,839
instagram wants to know what the wheels

1181
00:48:59,670 --> 00:48:58,000
of the rover are made out of

1182
00:49:01,670 --> 00:48:59,680
great question well you may think we

1183
00:49:04,150 --> 00:49:01,680
make them out of some material you've

1184
00:49:05,349 --> 00:49:04,160
never heard of it turns out they're made

1185
00:49:07,030 --> 00:49:05,359
of aluminum

1186
00:49:08,630 --> 00:49:07,040
now perseverance's wheels are a little

1187
00:49:11,510 --> 00:49:08,640
thicker than curiosities but they're

1188
00:49:14,069 --> 00:49:11,520

actually both made out of aluminum

1189
00:49:15,990 --> 00:49:14,079
and one more question for you can you

1190
00:49:18,470 --> 00:49:16,000
tell us more about the importance of

1191
00:49:21,510 --> 00:49:18,480
where you are right now in the building

1192
00:49:23,030 --> 00:49:21,520
yes i am above on the second floor above

1193
00:49:24,710 --> 00:49:23,040
the cruise mission support area that

1194
00:49:27,589 --> 00:49:24,720
you've been watching and this is the

1195
00:49:29,670 --> 00:49:27,599
surface mission support area so as soon

1196
00:49:31,990 --> 00:49:29,680
as perseverance lands

1197
00:49:34,390 --> 00:49:32,000
all commands i'll take this this room

1198
00:49:37,190 --> 00:49:34,400
will take over become headquarters for

1199
00:49:38,710 --> 00:49:37,200
operating perseverance on mars

1200
00:49:40,870 --> 00:49:38,720
thanks for taking the time to talk to us

1201
00:49:43,589 --> 00:49:40,880
today jennifer thank you

1202
00:49:44,630 --> 00:49:43,599
now we now know perseverance's place in

1203
00:49:47,589 --> 00:49:44,640
history

1204
00:49:51,030 --> 00:49:47,599
let's take an up close look at the rover

1205
00:49:53,750 --> 00:49:51,040
with mars 2020 system testbed engineer

1206
00:49:55,349 --> 00:49:53,760
elio morillo

1207
00:49:57,829 --> 00:49:55,359
thank you

1208
00:50:00,150 --> 00:49:57,839
i'm standing in front of the mars 2020

1209
00:50:02,950 --> 00:50:00,160
perseverance scaled model

1210
00:50:05,270 --> 00:50:02,960
as you can tell this vehicle is about

1211
00:50:07,109 --> 00:50:05,280
the size of a mini cooper these wheels

1212
00:50:08,630 --> 00:50:07,119
are obviously black here and they look

1213
00:50:10,470 --> 00:50:08,640

like rubber but they're actually fully

1214
00:50:12,309 --> 00:50:10,480
made of metal these wheels are designed

1215
00:50:14,870 --> 00:50:12,319
to allow us to climb over obstacles and

1216
00:50:16,710 --> 00:50:14,880
of course climb over hills and minimize

1217
00:50:18,950 --> 00:50:16,720
the amount of slipping once we're

1218
00:50:20,470 --> 00:50:18,960
traversing on the surface of mars

1219
00:50:22,630 --> 00:50:20,480
here in the front of the rover we have

1220
00:50:24,309 --> 00:50:22,640
the sample caching system and of course

1221
00:50:26,870 --> 00:50:24,319
at the very front end of this is the

1222
00:50:29,430 --> 00:50:26,880
robotic arm which this entire system is

1223
00:50:31,829 --> 00:50:29,440
arguably the most complex robotic system

1224
00:50:33,750 --> 00:50:31,839
we've ever sent outside of earth

1225
00:50:35,670 --> 00:50:33,760
here at the tip of the arm we have a

1226
00:50:37,990 --> 00:50:35,680
turret which contains a suite of

1227
00:50:39,990 --> 00:50:38,000
instruments along with some drills and

1228
00:50:42,549 --> 00:50:40,000
coring capabilities that will allow us

1229
00:50:45,349 --> 00:50:42,559
to do contact science once we get to the

1230
00:50:47,430 --> 00:50:45,359
surface of mars not only that

1231
00:50:49,750 --> 00:50:47,440
this robotic system is equipped to

1232
00:50:51,910 --> 00:50:49,760
collect samples about the size of a

1233
00:50:53,910 --> 00:50:51,920
piece of chalk that then eventually will

1234
00:50:56,309 --> 00:50:53,920
be stored inside of the vehicle and

1235
00:50:58,309 --> 00:50:56,319
dropped off in a later location so that

1236
00:51:00,150 --> 00:50:58,319
an eventual mission can go and return

1237
00:51:01,910 --> 00:51:00,160
these samples to earth something we've

1238
00:51:03,589 --> 00:51:01,920

never done in the past

1239
00:51:05,349 --> 00:51:03,599
here in the front we have the remote

1240
00:51:07,910 --> 00:51:05,359
sensing mast

1241
00:51:09,829 --> 00:51:07,920
something of note is that this mechanism

1242
00:51:11,270 --> 00:51:09,839
is going to be stowed upon the touchdown

1243
00:51:12,950 --> 00:51:11,280
on the surface of mars and one of the

1244
00:51:15,349 --> 00:51:12,960
first critical activities we do is

1245
00:51:17,190 --> 00:51:15,359
deploy this mechanism this mechanism

1246
00:51:18,710 --> 00:51:17,200
includes several cameras that are going

1247
00:51:20,870 --> 00:51:18,720
to give us some of the most breathtaking

1248
00:51:22,549 --> 00:51:20,880
images we've ever taken on mars along

1249
00:51:24,390 --> 00:51:22,559
with that we have some lasers as well as

1250
00:51:26,390 --> 00:51:24,400
a spectrometer they're going to allow us

1251
00:51:28,390 --> 00:51:26,400
to do some remote science

1252
00:51:29,750 --> 00:51:28,400
here you see some of these extrusions

1253
00:51:31,829 --> 00:51:29,760
that are part of the larger weather

1254
00:51:34,150 --> 00:51:31,839
suite of instruments that will allow us

1255
00:51:36,390 --> 00:51:34,160
to characterize the local climate around

1256
00:51:38,630 --> 00:51:36,400
perseverance so that's a quick tour of

1257
00:51:44,330 --> 00:51:38,640
the rover but i gotta get back to work

1258
00:51:57,750 --> 00:51:51,120
[Music]

1259
00:52:02,950 --> 00:51:59,990
perseverance is collecting samples of

1260
00:52:04,630 --> 00:52:02,960
martian rock for future return to earth

1261
00:52:07,349 --> 00:52:04,640
we've heard that scientists have been

1262
00:52:10,549 --> 00:52:07,359
wanting to bring martian samples back

1263
00:52:12,069 --> 00:52:10,559

for many generations and here to talk a

1264
00:52:14,549 --> 00:52:12,079
little bit about that is nasa's

1265
00:52:17,190 --> 00:52:14,559
planetary science division director lori

1266
00:52:19,750 --> 00:52:17,200
glaze who joins us now to talk about the

1267
00:52:23,589 --> 00:52:19,760
role perseverance will play in nasa's

1268
00:52:25,270 --> 00:52:23,599
future goals welcome lori hi

1269
00:52:26,630 --> 00:52:25,280
now as you just heard we've heard that

1270
00:52:28,950 --> 00:52:26,640
scientists have been wanting to bring

1271
00:52:31,030 --> 00:52:28,960
back these martian samples for a very

1272
00:52:33,589 --> 00:52:31,040
long time why do we need to bring them

1273
00:52:35,829 --> 00:52:33,599
back that's really a great great

1274
00:52:38,309 --> 00:52:35,839
question you know we actually have

1275
00:52:40,790 --> 00:52:38,319
examples of mars already here on earth

1276
00:52:42,790 --> 00:52:40,800
that came here as meteorites but we

1277
00:52:44,790 --> 00:52:42,800
don't know exactly where they came from

1278
00:52:46,630 --> 00:52:44,800
on mars and then they also have had to

1279
00:52:48,710 --> 00:52:46,640
make the trip from mars to earth and so

1280
00:52:50,549 --> 00:52:48,720
they got altered during that time and

1281
00:52:52,950 --> 00:52:50,559
then during their entry and descent into

1282
00:52:55,349 --> 00:52:52,960
the earth's atmosphere that also

1283
00:52:59,190 --> 00:52:55,359
changes what those those rocks are like

1284
00:53:01,109 --> 00:52:59,200
so being able to go to mars and actually

1285
00:53:03,910 --> 00:53:01,119
collect the sample where we know exactly

1286
00:53:05,910 --> 00:53:03,920
where it came from and we know we can

1287
00:53:07,750 --> 00:53:05,920
preserve it and keep it pristine and

1288
00:53:09,829 --> 00:53:07,760

carry it all the way back here this will

1289
00:53:12,069 --> 00:53:09,839
be incredibly important to help us

1290
00:53:14,630 --> 00:53:12,079
answer questions about

1291
00:53:17,109 --> 00:53:14,640
the geologic history of mars

1292
00:53:19,109 --> 00:53:17,119
understanding how it formed and evolved

1293
00:53:20,630 --> 00:53:19,119
and also really important questions

1294
00:53:22,870 --> 00:53:20,640
about whether or not

1295
00:53:24,390 --> 00:53:22,880
life actually existed on mars three and

1296
00:53:26,069 --> 00:53:24,400
a half billion years ago and whether

1297
00:53:29,270 --> 00:53:26,079
that life if it existed has been

1298
00:53:31,510 --> 00:53:29,280
preserved in the surface of mars

1299
00:53:33,670 --> 00:53:31,520
now lori these sample tubes that

1300
00:53:35,829 --> 00:53:33,680
perseverance is going to be collecting

1301
00:53:37,430 --> 00:53:35,839
they're the cleanest things ever created

1302
00:53:40,710 --> 00:53:37,440
on earth tell me a little bit about that

1303
00:53:42,790 --> 00:53:40,720
oh my goodness we worked so hard the

1304
00:53:45,670 --> 00:53:42,800
team here at jpl is absolutely

1305
00:53:48,150 --> 00:53:45,680
incredible to assure that those sample

1306
00:53:50,870 --> 00:53:48,160
tubes are incredibly clean

1307
00:53:53,829 --> 00:53:50,880
one of the main goals of this mission is

1308
00:53:55,750 --> 00:53:53,839
to be able to detect if there's actual

1309
00:53:58,150 --> 00:53:55,760
life that's preserved

1310
00:54:00,150 --> 00:53:58,160
ancient life preserved in those rocks in

1311
00:54:02,950 --> 00:54:00,160
those samples and we definitely don't

1312
00:54:04,630 --> 00:54:02,960
want to be carrying you know our own dna

1313
00:54:06,230 --> 00:54:04,640

off to mars and then bring it back here

1314
00:54:08,309 --> 00:54:06,240
to confuse our our scientists when

1315
00:54:11,589 --> 00:54:08,319
they're trying to study those samples so

1316
00:54:13,349 --> 00:54:11,599
it it is an incredibly clean uh set of

1317
00:54:15,109 --> 00:54:13,359
equipment that's been sent there as you

1318
00:54:17,030 --> 00:54:15,119
said the cleanest thing we've ever sent

1319
00:54:19,829 --> 00:54:17,040
into space

1320
00:54:21,829 --> 00:54:19,839
now this is a very complicated campaign

1321
00:54:23,990 --> 00:54:21,839
can you break down for us how it's going

1322
00:54:25,589 --> 00:54:24,000
to work and if there's any international

1323
00:54:27,510 --> 00:54:25,599
partners working with us

1324
00:54:30,710 --> 00:54:27,520
you are correct the the marsh sample

1325
00:54:32,710 --> 00:54:30,720
return campaign is incredibly complex in

1326
00:54:34,790 --> 00:54:32,720
fact it's probably the most challenging

1327
00:54:36,390 --> 00:54:34,800
thing we've ever tried to do

1328
00:54:39,349 --> 00:54:36,400
but we're definitely not going to try

1329
00:54:42,390 --> 00:54:39,359
and do it alone we have great partners

1330
00:54:44,470 --> 00:54:42,400
with the european space agency and the

1331
00:54:46,470 --> 00:54:44,480
way this campaign is going to work well

1332
00:54:49,109 --> 00:54:46,480
perseverance is the first step chapter

1333
00:54:52,390 --> 00:54:49,119
one uh is going to mars and collecting

1334
00:54:54,470 --> 00:54:52,400
the samples chapter two is going to be a

1335
00:54:58,390 --> 00:54:54,480
sample return lander that we hope to

1336
00:55:00,789 --> 00:54:58,400
launch in around 26 to 28 2026 to 2028

1337
00:55:03,270 --> 00:55:00,799
and that lander uh it'll be an american

1338
00:55:05,589 --> 00:55:03,280

lander carrying a fetch rover that's

1339
00:55:07,750 --> 00:55:05,599
provided by european space agency and

1340
00:55:09,190 --> 00:55:07,760
that little fetch rover will drive out

1341
00:55:11,910 --> 00:55:09,200
and pick up the samples that

1342
00:55:13,349 --> 00:55:11,920
perseverance left on the surface of mars

1343
00:55:15,670 --> 00:55:13,359
and the fetch river will bring them back

1344
00:55:17,270 --> 00:55:15,680
and load them into a rocket that we call

1345
00:55:18,950 --> 00:55:17,280
the mars ascent vehicle which will be

1346
00:55:21,510 --> 00:55:18,960
the first ever launch from another

1347
00:55:24,470 --> 00:55:21,520
planet and it will launch those samples

1348
00:55:26,549 --> 00:55:24,480
into orbit around mars in the meantime

1349
00:55:29,109 --> 00:55:26,559
european space agency will have an

1350
00:55:31,990 --> 00:55:29,119
orbiter that's in orbit around mars that

1351
00:55:34,309 --> 00:55:32,000
can rendezvous and capture those samples

1352
00:55:36,710 --> 00:55:34,319
and then bring them back to earth for

1353
00:55:39,190 --> 00:55:36,720
for us to study back here in our amazing

1354
00:55:41,829 --> 00:55:39,200
laboratories

1355
00:55:44,230 --> 00:55:41,839
a lot of firsts it sounds like lori and

1356
00:55:46,470 --> 00:55:44,240
another first how is perseverance and

1357
00:55:48,630 --> 00:55:46,480
the mars sample return mission going to

1358
00:55:50,390 --> 00:55:48,640
help the future exploration human

1359
00:55:52,230 --> 00:55:50,400
exploration of mars

1360
00:55:55,589 --> 00:55:52,240
i'm so glad you asked that i think we're

1361
00:55:58,150 --> 00:55:55,599
going to get a lot of great information

1362
00:56:00,549 --> 00:55:58,160
from mars sample return with again being

1363
00:56:02,710 --> 00:56:00,559

able to land the heaviest payload we've

1364
00:56:05,109 --> 00:56:02,720
ever landed on mars will be that sample

1365
00:56:07,109 --> 00:56:05,119
return lander that's critical to us

1366
00:56:08,630 --> 00:56:07,119
learning how to land humans on mars and

1367
00:56:10,470 --> 00:56:08,640
then we are definitely going to want to

1368
00:56:12,470 --> 00:56:10,480
be able to launch the humans back off of

1369
00:56:14,390 --> 00:56:12,480
mars so that mars ascent vehicle is

1370
00:56:16,390 --> 00:56:14,400
going to be critical that that first

1371
00:56:18,069 --> 00:56:16,400
step of the first launch from another

1372
00:56:20,630 --> 00:56:18,079
planet

1373
00:56:22,950 --> 00:56:20,640
so exciting laurie and speaking about

1374
00:56:25,349 --> 00:56:22,960
the mars generation we're now going to

1375
00:56:27,109 --> 00:56:25,359
take a student question for you from

1376
00:56:32,549 --> 00:56:27,119
livia

1377
00:56:35,190 --> 00:56:32,559
what made you want to study mars and why

1378
00:56:39,910 --> 00:56:35,200
are you working so hard and willing to

1379
00:56:45,109 --> 00:56:42,710
olivia that is such a great question and

1380
00:56:47,430 --> 00:56:45,119
and i enjoy mars just because it can

1381
00:56:49,670 --> 00:56:47,440
tell us so much about how our solar

1382
00:56:51,270 --> 00:56:49,680
system formed and evolved um all of the

1383
00:56:53,109 --> 00:56:51,280
planets can tell us different parts of

1384
00:56:55,030 --> 00:56:53,119
that story and mars is a really key

1385
00:56:57,349 --> 00:56:55,040
piece of that and one of the main

1386
00:57:00,230 --> 00:56:57,359
reasons we're willing to wait so long to

1387
00:57:02,150 --> 00:57:00,240
get the sample back is that we've got

1388
00:57:05,270 --> 00:57:02,160

great new scientists that are all about

1389
00:57:07,030 --> 00:57:05,280
your age and in about 10 or 15 or 20

1390
00:57:09,109 --> 00:57:07,040
years you'll be the generation that's

1391
00:57:11,510 --> 00:57:09,119
going to actually get to work with these

1392
00:57:13,750 --> 00:57:11,520
samples when when they come back you'll

1393
00:57:16,710 --> 00:57:13,760
be the scientists and engineers that

1394
00:57:19,030 --> 00:57:16,720
will will be the the next generation to

1395
00:57:20,950 --> 00:57:19,040
to change how we think about uh about

1396
00:57:23,109 --> 00:57:20,960
mars and how we think about life in the

1397
00:57:25,270 --> 00:57:23,119
solar system

1398
00:57:27,829 --> 00:57:25,280
that was a great question lori reach for

1399
00:57:29,910 --> 00:57:27,839
the stars future little scientists and

1400
00:57:31,829 --> 00:57:29,920
engineers thank you so much for joining

1401
00:57:33,829 --> 00:57:31,839
us here today lori it's my pleasure

1402
00:57:35,270 --> 00:57:33,839
thanks back to you raquel for another

1403
00:57:37,510 --> 00:57:35,280
mission update

1404
00:57:39,670 --> 00:57:37,520
thanks marina the cruise team for

1405
00:57:42,870 --> 00:57:39,680
perseverance controls the rover on its

1406
00:57:45,750 --> 00:57:42,880
way to mars and moments ago they handed

1407
00:57:47,829 --> 00:57:45,760
it over to the landing team and it looks

1408
00:57:50,710 --> 00:57:47,839
like team leaders in mission control are

1409
00:57:52,309 --> 00:57:50,720
about to talk to both teams so let's

1410
00:57:54,470 --> 00:57:52,319
listen in

1411
00:57:57,109 --> 00:57:54,480
the cbm change uh as i mentioned

1412
00:58:00,069 --> 00:57:57,119
previously is to the edl reserve two-way

1413
00:58:01,829 --> 00:58:00,079

non-coherent level activity

1414
00:58:06,950 --> 00:58:01,839
copy flight

1415
00:58:11,589 --> 00:58:09,510
tough talk i guess to the team

1416
00:58:13,349 --> 00:58:11,599
right uh you know i'm terrible pep talks

1417
00:58:16,069 --> 00:58:13,359
i think you my

1418
00:58:17,349 --> 00:58:16,079
reputation precedes me there and uh

1419
00:58:18,789 --> 00:58:17,359
look i know this hasn't been easy right

1420
00:58:20,150 --> 00:58:18,799
i'm not even sure we've even been all in

1421
00:58:22,470 --> 00:58:20,160
the same room at the same time i mean

1422
00:58:24,549 --> 00:58:22,480
i'm staring at folks across the uh

1423
00:58:28,470 --> 00:58:24,559
across the internet as well uh even now

1424
00:58:30,710 --> 00:58:29,430
yeah

1425
00:58:31,829 --> 00:58:30,720
voice check

1426
00:58:33,990 --> 00:58:31,839
okay

1427
00:58:36,150 --> 00:58:34,000
um i do want to just extend uh my

1428
00:58:38,470 --> 00:58:36,160
heartfelt appreciation from the edl team

1429
00:58:39,910 --> 00:58:38,480
to the uh to the launch cruise team uh

1430
00:58:41,910 --> 00:58:39,920
you've done everything we've asked for

1431
00:58:43,589 --> 00:58:41,920
right i mean you've battled anomalies

1432
00:58:44,710 --> 00:58:43,599
you've you know dealt with cessies he's

1433
00:58:46,950 --> 00:58:44,720
done everything

1434
00:58:48,549 --> 00:58:46,960
he delivered a healthy spacecraft to the

1435
00:58:50,069 --> 00:58:48,559
place that we want to go

1436
00:58:51,349 --> 00:58:50,079
and she's right on target right he did

1437
00:58:53,510 --> 00:58:51,359
the last maneuver literally two months

1438
00:58:54,630 --> 00:58:53,520

ago right this is pretty incredible in

1439
00:58:55,990 --> 00:58:54,640
my opinion

1440
00:58:57,190 --> 00:58:56,000
um and she's armed with the right

1441
00:58:59,109 --> 00:58:57,200
information to help us land you know

1442
00:59:00,309 --> 00:58:59,119
doing the founder update last night

1443
00:59:01,430 --> 00:59:00,319
we're ready to roll you've done

1444
00:59:03,030 --> 00:59:01,440
everything right

1445
00:59:04,470 --> 00:59:03,040
um and you've put up with us too right

1446
00:59:05,270 --> 00:59:04,480
you've put up with our eccentricities

1447
00:59:09,190 --> 00:59:05,280
and

1448
00:59:11,109 --> 00:59:09,200
i very much appreciate that

1449
00:59:12,309 --> 00:59:11,119
so uh you all should sleep in on friday

1450
00:59:15,190 --> 00:59:12,319
since uh

1451
00:59:16,549 --> 00:59:15,200
i you know you guys have earned it um

1452
00:59:17,670 --> 00:59:16,559
thanks for literally and figuratively

1453
00:59:18,549 --> 00:59:17,680
putting us in the right position to

1454
00:59:19,510 --> 00:59:18,559
succeed

1455
00:59:26,309 --> 00:59:19,520
and

1456
00:59:27,990 --> 00:59:26,319
as flight director i also would like to

1457
00:59:31,030 --> 00:59:28,000
thank the whole team

1458
00:59:34,390 --> 00:59:31,040
crewsops edl ops

1459
00:59:36,309 --> 00:59:34,400
edl team and the surface ops as well

1460
00:59:38,150 --> 00:59:36,319
it's been an amazing journey i think we

1461
00:59:39,750 --> 00:59:38,160
all know that and

1462
00:59:42,309 --> 00:59:39,760
it's been my honor and pleasure to work

1463
00:59:45,109 --> 00:59:42,319

with you all side by side

1464
00:59:46,390 --> 00:59:45,119
and your tireless efforts and endurance

1465
00:59:48,549 --> 00:59:46,400
in the face

1466
00:59:51,109 --> 00:59:48,559
of our challenges has been

1467
00:59:52,630 --> 00:59:51,119
truly truly inspiring so

1468
00:59:55,030 --> 00:59:52,640
kudos to you

1469
00:59:57,270 --> 00:59:55,040
mission would you like to see something

1470
00:59:59,109 --> 00:59:57,280
yeah just echoing the same words that uh

1471
01:00:01,829 --> 00:59:59,119
that al and maggie have uh have

1472
01:00:03,430 --> 01:00:01,839
mentioned you guys have overcome great

1473
01:00:05,750 --> 01:00:03,440
obstacles in the last six and a half

1474
01:00:08,309 --> 01:00:05,760
months and it started with an earthquake

1475
01:00:09,510 --> 01:00:08,319
in this room on launch day at l minus 20

1476
01:00:10,470 --> 01:00:09,520
minutes

1477
01:00:12,870 --> 01:00:10,480
so

1478
01:00:14,870 --> 01:00:12,880
i can't be more proud than all of the

1479
01:00:16,630 --> 01:00:14,880
achievements that you guys have have

1480
01:00:17,670 --> 01:00:16,640
pulled off in the last six and a half

1481
01:00:19,750 --> 01:00:17,680
months

1482
01:00:21,510 --> 01:00:19,760
whatever happens in the next hour and a

1483
01:00:23,430 --> 01:00:21,520
half you can be proud of the

1484
01:00:24,230 --> 01:00:23,440
achievements that you've accomplished so

1485
01:00:25,670 --> 01:00:24,240
far

1486
01:00:26,710 --> 01:00:25,680
i look forward to seeing you on the

1487
01:00:28,230 --> 01:00:26,720
other side

1488
01:00:29,750 --> 01:00:28,240

and i only wish that the rest of our

1489
01:00:32,950 --> 01:00:29,760
team could be sharing this moment with

1490
01:00:35,270 --> 01:00:32,960
us uh this is a very unusual event

1491
01:00:36,309 --> 01:00:35,280
this room is only as half as full as it

1492
01:00:38,390 --> 01:00:36,319
would be

1493
01:00:40,230 --> 01:00:38,400
if we weren't in this pandemic so

1494
01:00:45,030 --> 01:00:40,240
missing everybody on the team who's not

1495
01:00:48,080 --> 01:00:45,040
with us here today and go edl

1496
01:00:55,670 --> 01:00:48,090
welcome to the edel family

1497
01:01:01,109 --> 01:00:55,680
[Applause]

1498
01:01:05,349 --> 01:01:03,190
all right activity

1499
01:01:07,349 --> 01:01:05,359
go ahead and continue the report

1500
01:01:10,309 --> 01:01:07,359
sure thing fight um we've since

1501
01:01:12,630 --> 01:01:10,319
completed the edl start anchor

1502
01:01:15,670 --> 01:01:12,640
as i was mentioning we changed our cbm

1503
01:01:18,150 --> 01:01:15,680
row to edl reserve two-way non-coherent

1504
01:01:19,430 --> 01:01:18,160
that row reinforces our cbm windows

1505
01:01:21,829 --> 01:01:19,440
disabled

1506
01:01:23,270 --> 01:01:21,839
keeps our packetization on it turns off

1507
01:01:25,990 --> 01:01:23,280
our ranging and switches to the

1508
01:01:28,390 --> 01:01:26,000
auxiliary oscillator we have also

1509
01:01:31,430 --> 01:01:28,400
started our real-time data products

1510
01:01:32,950 --> 01:01:31,440
and reinforced medley on

1511
01:01:35,109 --> 01:01:32,960
at this time

1512
01:01:37,510 --> 01:01:35,119
now we just heard perseverance team

1513
01:01:40,549 --> 01:01:37,520

leaders thank the cruise team for their

1514
01:01:42,870 --> 01:01:40,559
work in guiding the rover to mars now

1515
01:01:45,750 --> 01:01:42,880
did you know the rover name and mars

1516
01:01:48,069 --> 01:01:45,760
helicopter name came from students well

1517
01:01:50,630 --> 01:01:48,079
a couple weeks ago marina was able to

1518
01:01:53,510 --> 01:01:50,640
catch up with them

1519
01:01:55,910 --> 01:01:53,520
thanks raquel earlier this year nasa and

1520
01:01:59,190 --> 01:01:55,920
our partners held a nationwide essay

1521
01:02:01,589 --> 01:01:59,200
contest to name our mars rover alex

1522
01:02:04,069 --> 01:02:01,599
mather a seventh grader from springfield

1523
01:02:06,390 --> 01:02:04,079
virginia submitted the winning essay

1524
01:02:10,069 --> 01:02:06,400
that was selected by nasa from a field

1525
01:02:12,150 --> 01:02:10,079
of more than 28 000 entries from k

1526
01:02:14,710 --> 01:02:12,160
through 12 students in every state in

1527
01:02:17,589 --> 01:02:14,720
the u.s vanessa rouhani's essay for

1528
01:02:19,430 --> 01:02:17,599
ingenuity was so compelling nasa thought

1529
01:02:22,069 --> 01:02:19,440
it would be a perfect name for the

1530
01:02:23,829 --> 01:02:22,079
history making helicopter a technology

1531
01:02:26,630 --> 01:02:23,839
demonstration carried aboard the

1532
01:02:28,710 --> 01:02:26,640
perseverance rover alex and vanessa join

1533
01:02:31,109 --> 01:02:28,720
us now welcome you guys

1534
01:02:33,190 --> 01:02:31,119
hello space nerds

1535
01:02:35,430 --> 01:02:33,200
hi

1536
01:02:38,549 --> 01:02:35,440
now you got to go to florida and watch

1537
01:02:40,630 --> 01:02:38,559
the launch live back in july alex what

1538
01:02:42,230 --> 01:02:40,640

were you feeling as you saw that rocket

1539
01:02:44,549 --> 01:02:42,240
launch into the sky

1540
01:02:47,349 --> 01:02:44,559
i read a lot of books written by

1541
01:02:50,870 --> 01:02:47,359
astronauts and every single one of them

1542
01:02:53,029 --> 01:02:50,880
always talks about the raw power

1543
01:02:55,109 --> 01:02:53,039
behind the space launch

1544
01:02:58,950 --> 01:02:55,119
and i definitely feel like watching the

1545
01:03:01,510 --> 01:02:58,960
launch invoked that sense of

1546
01:03:04,069 --> 01:03:01,520
of well inspiration mixed with

1547
01:03:05,270 --> 01:03:04,079
anticipation along with that rumble in

1548
01:03:08,069 --> 01:03:05,280
my chest

1549
01:03:10,150 --> 01:03:08,079
that's very inspirational and i'm sure

1550
01:03:12,069 --> 01:03:10,160
that you have had many conversations

1551
01:03:13,829 --> 01:03:12,079
with your classmates since this all

1552
01:03:14,950 --> 01:03:13,839
began what kind of questions have they

1553
01:03:17,430 --> 01:03:14,960
asked you

1554
01:03:19,430 --> 01:03:17,440
i got some people asking me about what

1555
01:03:21,270 --> 01:03:19,440
this helicopter is what this rover is

1556
01:03:23,270 --> 01:03:21,280
what are they actually going to do

1557
01:03:24,549 --> 01:03:23,280
so i love that this whole experience

1558
01:03:26,870 --> 01:03:24,559
sparked a greater interest in the

1559
01:03:28,870 --> 01:03:26,880
mission in my community why do you think

1560
01:03:31,190 --> 01:03:28,880
it's so important for kids to be

1561
01:03:34,309 --> 01:03:31,200
inspired by space exploration

1562
01:03:37,029 --> 01:03:34,319
because space is the future and kids are

1563
01:03:39,589 --> 01:03:37,039

the future learning about space and

1564
01:03:42,470 --> 01:03:39,599
watching the story of humanity spread to

1565
01:03:45,670 --> 01:03:42,480
the stars happen is watching the future

1566
01:03:48,309 --> 01:03:45,680
happen and seeing history unfold

1567
01:03:49,990 --> 01:03:48,319
the best way to keep our home safe and

1568
01:03:52,069 --> 01:03:50,000
protect our planet is to learn from the

1569
01:03:53,510 --> 01:03:52,079
worlds around it so i think it's really

1570
01:03:55,349 --> 01:03:53,520
important for the next generation of

1571
01:03:56,950 --> 01:03:55,359
scientists to be engaged in that type of

1572
01:03:59,029 --> 01:03:56,960
exploration to make our home the best

1573
01:04:01,349 --> 01:03:59,039
place it can be

1574
01:04:03,270 --> 01:04:01,359
now speaking of the future what has your

1575
01:04:06,069 --> 01:04:03,280
life been like since naming the rover

1576
01:04:09,029 --> 01:04:06,079
and helicopter has it sparked any future

1577
01:04:12,230 --> 01:04:09,039
aspirations for the two of you

1578
01:04:14,309 --> 01:04:12,240
oh man i am currently applying to a

1579
01:04:15,190 --> 01:04:14,319
science and technology school for high

1580
01:04:17,270 --> 01:04:15,200
school

1581
01:04:19,670 --> 01:04:17,280
i'm hoping for a nasa internship

1582
01:04:22,470 --> 01:04:19,680
sometime along the way with my ultimate

1583
01:04:24,789 --> 01:04:22,480
goal being to join the incredible team

1584
01:04:26,549 --> 01:04:24,799
of scientists and engineers who are

1585
01:04:28,230 --> 01:04:26,559
about to make this happen

1586
01:04:29,750 --> 01:04:28,240
this whole experience has definitely

1587
01:04:32,069 --> 01:04:29,760
shown me that i want to go into the

1588
01:04:33,670 --> 01:04:32,079

space industry i came home from florida

1589
01:04:35,510 --> 01:04:33,680
did all my college applications and

1590
01:04:37,510 --> 01:04:35,520
checked aerospace engineering on all the

1591
01:04:38,870 --> 01:04:37,520
boxes i mean the whole time we were

1592
01:04:41,029 --> 01:04:38,880
there i was thinking why would anyone

1593
01:04:44,230 --> 01:04:41,039
want to do anything else

1594
01:04:46,309 --> 01:04:44,240
so true and the best of luck to both of

1595
01:04:49,029 --> 01:04:46,319
you thank you so much for joining us

1596
01:04:50,870 --> 01:04:49,039
here today alex and vanessa

1597
01:04:52,870 --> 01:04:50,880
thank you for having us thank you so

1598
01:04:57,109 --> 01:04:52,880
much i had a great time

1599
01:04:59,349 --> 01:04:57,119
now your essays as well as the top 155

1600
01:05:02,470 --> 01:04:59,359
finalist essays are riding on the

1601
01:05:04,950 --> 01:05:02,480
perseverance rover along with nearly 11

1602
01:05:07,349 --> 01:05:04,960
million of the names from all over the

1603
01:05:09,270 --> 01:05:07,359
world that were submitted before launch

1604
01:05:11,510 --> 01:05:09,280
and if you miss the chance to get your

1605
01:05:13,430 --> 01:05:11,520
name on perseverance then you will get

1606
01:05:15,510 --> 01:05:13,440
another chance to reserve a spot on the

1607
01:05:19,029 --> 01:05:15,520
next mission to mars so make sure that

1608
01:05:22,630 --> 01:05:19,039
you sign up now at mars.nasa.gov

1609
01:05:24,789 --> 01:05:22,640
for your boarding pass

1610
01:05:27,109 --> 01:05:24,799
as virtual celebrations are happening

1611
01:05:29,670 --> 01:05:27,119
all over the globe let's take a look at

1612
01:05:31,670 --> 01:05:29,680
some of your submissions on our social

1613
01:05:34,390 --> 01:05:31,680

channels showing us how you're

1614
01:05:38,150 --> 01:05:34,400
celebrating the perseverance landing

1615
01:05:41,270 --> 01:05:38,160
right now and remember to hashtag count

1616
01:05:44,309 --> 01:05:41,280
down to mars and send those in we would

1617
01:05:46,950 --> 01:05:44,319
love to show them off

1618
01:05:49,510 --> 01:05:46,960
look at these kids they are getting so

1619
01:05:51,829 --> 01:05:49,520
excited everyone's watching it a lot of

1620
01:05:54,470 --> 01:05:51,839
classrooms are watching it oh and great

1621
01:05:57,349 --> 01:05:54,480
someone did a lego version of

1622
01:05:59,670 --> 01:05:57,359
perseverance which is awesome

1623
01:06:01,349 --> 01:05:59,680
it looks fantastic we love getting all

1624
01:06:03,589 --> 01:06:01,359
your pictures out there we've gotten a

1625
01:06:05,589 --> 01:06:03,599
lot of artwork from kids which has been

1626
01:06:08,789 --> 01:06:05,599
great i know i have a nine-year-old john

1627
01:06:10,789 --> 01:06:08,799
at home and he loves to draw the rover

1628
01:06:12,309 --> 01:06:10,799
and look at that that is awesome that's

1629
01:06:15,109 --> 01:06:12,319
better than anything i could bake that's

1630
01:06:17,270 --> 01:06:15,119
for sure perseverance in a cake

1631
01:06:20,150 --> 01:06:17,280
that looks so great delicious i want to

1632
01:06:26,470 --> 01:06:23,349
another great send-in from david bowie

1633
01:06:29,910 --> 01:06:27,990
thank you so much for your submissions

1634
01:06:31,829 --> 01:06:29,920
remember hashtag countdown to mars we

1635
01:06:33,910 --> 01:06:31,839
love to see how you're celebrating now

1636
01:06:36,390 --> 01:06:33,920
you might know our next guest from shows

1637
01:06:39,349 --> 01:06:36,400
like emily's wonder lab joining me now

1638
01:06:42,150 --> 01:06:39,359

is emily kelandrelli thank you so much

1639
01:06:44,390 --> 01:06:42,160
for being here with us today

1640
01:06:46,230 --> 01:06:44,400
hi thanks so much for having me

1641
01:06:48,069 --> 01:06:46,240
now you are very passionate about

1642
01:06:50,630 --> 01:06:48,079
getting kids interested in science and

1643
01:06:53,990 --> 01:06:50,640
space exploration why do you think kids

1644
01:06:55,910 --> 01:06:54,000
are so excited about space

1645
01:06:57,589 --> 01:06:55,920
well i know the reason i'm excited about

1646
01:06:59,430 --> 01:06:57,599
space and i think it's the same reason

1647
01:07:01,510 --> 01:06:59,440
that many others are excited about space

1648
01:07:04,069 --> 01:07:01,520
and it's that the people in the space

1649
01:07:06,390 --> 01:07:04,079
industry work to answer two of the

1650
01:07:09,349 --> 01:07:06,400
biggest questions that humans have ever

1651
01:07:11,670 --> 01:07:09,359
asked are we alone in the universe and

1652
01:07:13,990 --> 01:07:11,680
where did we all come from and by

1653
01:07:16,309 --> 01:07:14,000
sending a rover to mars we are gaining

1654
01:07:18,150 --> 01:07:16,319
evidence for the answers to these

1655
01:07:21,910 --> 01:07:18,160
questions more evidence than we ever had

1656
01:07:23,910 --> 01:07:21,920
before and i think that's so exciting

1657
01:07:25,910 --> 01:07:23,920
it is and i know you get loads of

1658
01:07:28,549 --> 01:07:25,920
interesting questions from kids have you

1659
01:07:30,950 --> 01:07:28,559
gotten any about mars specifically

1660
01:07:33,349 --> 01:07:30,960
oh my gosh yes everybody loves smarts

1661
01:07:34,789 --> 01:07:33,359
it's in movies and books and tv shows

1662
01:07:36,710 --> 01:07:34,799
and everybody loves mars so one of the

1663
01:07:38,789 --> 01:07:36,720

things that i get asked a lot is that

1664
01:07:41,190 --> 01:07:38,799
you know it's called the red planet why

1665
01:07:44,309 --> 01:07:41,200
is it red well it's red because it's

1666
01:07:47,109 --> 01:07:44,319
literally rusty the top layer of soil on

1667
01:07:49,670 --> 01:07:47,119
mars has iron oxide in it or rust and

1668
01:07:52,150 --> 01:07:49,680
rust has that brownish red color so it's

1669
01:07:55,029 --> 01:07:52,160
it's red because it's rusty and also

1670
01:07:57,430 --> 01:07:55,039
because it's red they ask is it red hot

1671
01:07:59,270 --> 01:07:57,440
is it really hot on mars and well no

1672
01:08:00,950 --> 01:07:59,280
actually it's colder than the earth it's

1673
01:08:02,390 --> 01:08:00,960
farther away from the sun so as you

1674
01:08:04,789 --> 01:08:02,400
would imagine it's a little bit colder

1675
01:08:07,430 --> 01:08:04,799
than the earth it also has a really thin

1676
01:08:09,750 --> 01:08:07,440
atmosphere so the heat that it does have

1677
01:08:11,510 --> 01:08:09,760
it has a hard time keeping in

1678
01:08:13,910 --> 01:08:11,520
and so it's a little bit colder but then

1679
01:08:16,470 --> 01:08:13,920
i also get asked what would i weigh on

1680
01:08:18,390 --> 01:08:16,480
mars that's a really fun question so on

1681
01:08:20,229 --> 01:08:18,400
mars it's a little bit smaller than the

1682
01:08:22,390 --> 01:08:20,239
earth so the gravity there is weaker

1683
01:08:24,470 --> 01:08:22,400
it's about 3 8 the gravity that we have

1684
01:08:26,390 --> 01:08:24,480
here on earth so if you wait 100 pounds

1685
01:08:28,630 --> 01:08:26,400
here on earth you weigh 38 pounds on

1686
01:08:31,349 --> 01:08:28,640
mars or 100 kilograms here on earth 38

1687
01:08:33,030 --> 01:08:31,359
kilograms on mars

1688
01:08:34,550 --> 01:08:33,040

those are all super fun i think even

1689
01:08:36,550 --> 01:08:34,560
some adults want to know the answers to

1690
01:08:38,390 --> 01:08:36,560
those questions emily

1691
01:08:40,709 --> 01:08:38,400
now why do you think it's so important

1692
01:08:43,430 --> 01:08:40,719
to educate kids about science and give

1693
01:08:46,550 --> 01:08:43,440
them that great foundation

1694
01:08:48,309 --> 01:08:46,560
well science is the language of nature

1695
01:08:50,789 --> 01:08:48,319
and learning about science and learning

1696
01:08:52,950 --> 01:08:50,799
how to think like a scientist means you

1697
01:08:55,349 --> 01:08:52,960
are learning how to systematically seek

1698
01:08:56,950 --> 01:08:55,359
out truth in the world you are learning

1699
01:08:58,630 --> 01:08:56,960
the scientific method you're learning

1700
01:09:00,630 --> 01:08:58,640
how to be a critical thinker and

1701
01:09:02,229 --> 01:09:00,640
honestly those skills are great for

1702
01:09:03,349 --> 01:09:02,239
whatever you end up wanting to do in

1703
01:09:05,189 --> 01:09:03,359
life

1704
01:09:07,510 --> 01:09:05,199
true if you want to be a scientist or an

1705
01:09:10,229 --> 01:09:07,520
opera singer that holds true what are

1706
01:09:11,269 --> 01:09:10,239
you most excited about today

1707
01:09:14,070 --> 01:09:11,279
i mean

1708
01:09:16,149 --> 01:09:14,080
humans are launching a robot to mars

1709
01:09:17,990 --> 01:09:16,159
that doesn't happen every day i think in

1710
01:09:20,070 --> 01:09:18,000
all of the hecticness that is going on

1711
01:09:22,309 --> 01:09:20,080
today and all of the nerves i just

1712
01:09:24,789 --> 01:09:22,319
everyone can take a moment to sit back

1713
01:09:27,030 --> 01:09:24,799

and remember that we live in a time when

1714
01:09:29,189 --> 01:09:27,040
humans have the ability to send a robot

1715
01:09:31,669 --> 01:09:29,199
to another planet and that is just

1716
01:09:34,470 --> 01:09:31,679
that's so cool to me

1717
01:09:36,630 --> 01:09:34,480
it is very cool emily take a deep breath

1718
01:09:37,990 --> 01:09:36,640
thanks for joining us here

1719
01:09:40,229 --> 01:09:38,000
thanks for having me

1720
01:09:43,510 --> 01:09:40,239
sending it back to you now raquel

1721
01:09:46,070 --> 01:09:43,520
thanks marina we are offering lots of

1722
01:09:48,390 --> 01:09:46,080
ways to ride along with us to mars now

1723
01:09:50,950 --> 01:09:48,400
put yourself right into the action now

1724
01:09:53,189 --> 01:09:50,960
with our perseverance photo booth you

1725
01:09:56,070 --> 01:09:53,199
can pose next to the rover place

1726
01:09:57,669 --> 01:09:56,080
yourself in our mission control and even

1727
01:09:59,910 --> 01:09:57,679
see what you might look like taking a

1728
01:10:01,830 --> 01:09:59,920
selfie on the red planet

1729
01:10:04,149 --> 01:10:01,840
there you'll also have a chance to sign

1730
01:10:06,870 --> 01:10:04,159
up to send your name to mars on nasa's

1731
01:10:10,470 --> 01:10:06,880
next flight to the red planet it's all

1732
01:10:13,430 --> 01:10:10,480
available at go.nasa.gov

1733
01:10:17,350 --> 01:10:13,440
mars 2020 toolkit

1734
01:10:20,390 --> 01:10:17,360
and joining us now is jpl chief engineer

1735
01:10:22,470 --> 01:10:20,400
and landing veteran rob manning he will

1736
01:10:24,709 --> 01:10:22,480
be breaking down key moments coming up

1737
01:10:27,430 --> 01:10:24,719
and very few people know more about

1738
01:10:30,950 --> 01:10:27,440

landing on mars than rob going back to

1739
01:10:33,110 --> 01:10:30,960
the pathfinder mission in 1997.

1740
01:10:34,870 --> 01:10:33,120
thanks for joining us today rob yeah

1741
01:10:37,189 --> 01:10:34,880
thank you very much rick

1742
01:10:38,390 --> 01:10:37,199
for having me here and what a wonderful

1743
01:10:40,390 --> 01:10:38,400
experience

1744
01:10:42,070 --> 01:10:40,400
what a wonderful day for a beautiful day

1745
01:10:44,470 --> 01:10:42,080
in california

1746
01:10:46,790 --> 01:10:44,480
we we're just so excited here anxious

1747
01:10:48,630 --> 01:10:46,800
worried but very hopeful

1748
01:10:51,030 --> 01:10:48,640
rob i have a question for you there is a

1749
01:10:53,669 --> 01:10:51,040
landing tradition at jpl that involves

1750
01:10:55,430 --> 01:10:53,679
eating peanuts for good luck uh can you

1751
01:10:57,990 --> 01:10:55,440
tell us how did that start

1752
01:11:00,390 --> 01:10:58,000
yes it started in the mid 1960s what

1753
01:11:02,870 --> 01:11:00,400
happened was we had a series of missions

1754
01:11:05,669 --> 01:11:02,880
that had failures the ranger program in

1755
01:11:07,990 --> 01:11:05,679
the early 1960s and one after another

1756
01:11:09,350 --> 01:11:08,000
failed and what happened was one day a

1757
01:11:11,910 --> 01:11:09,360
fellow by the name of dick wallace on

1758
01:11:14,790 --> 01:11:11,920
the on ranger number seven on the

1759
01:11:16,870 --> 01:11:14,800
seventh attempt decided to bring peanuts

1760
01:11:19,270 --> 01:11:16,880
to the ops area just before the before

1761
01:11:21,189 --> 01:11:19,280
the launch and guess what that mission

1762
01:11:23,270 --> 01:11:21,199
worked now we're not supposed to be too

1763
01:11:25,030 --> 01:11:23,280

super superstitious we're engineers and

1764
01:11:27,350 --> 01:11:25,040
scientists after all but we love

1765
01:11:28,950 --> 01:11:27,360
tradition and ever since then before

1766
01:11:30,310 --> 01:11:28,960
launch and before critical events like

1767
01:11:31,510 --> 01:11:30,320
enter descent landing we have brought

1768
01:11:33,350 --> 01:11:31,520
out peanuts and shared them with the

1769
01:11:35,350 --> 01:11:33,360
team and it's been really a wonderful

1770
01:11:37,030 --> 01:11:35,360
little experience and and so this is

1771
01:11:39,510 --> 01:11:37,040
something we will do we're doing right

1772
01:11:41,270 --> 01:11:39,520
now and uh and it's something that we we

1773
01:11:43,189 --> 01:11:41,280
just can't help ourselves it's just part

1774
01:11:47,270 --> 01:11:43,199
of the experience

1775
01:11:49,430 --> 01:11:47,280
the perseverance team keep the tradition

1776
01:11:51,189 --> 01:11:49,440
alive this year well this year we're

1777
01:11:53,030 --> 01:11:51,199
passed out little packets of penis to

1778
01:11:54,390 --> 01:11:53,040
the team and they can sneak a pic one

1779
01:11:56,310 --> 01:11:54,400
peanut in their mouth

1780
01:11:58,229 --> 01:11:56,320
for uh as part of to keep the tradition

1781
01:11:59,830 --> 01:11:58,239
alive but you know this is part of the

1782
01:12:00,630 --> 01:11:59,840
covet experience but we can't leave this

1783
01:12:04,709 --> 01:12:00,640
one

1784
01:12:06,310 --> 01:12:04,719
we're and uh and this is gonna help us

1785
01:12:07,910 --> 01:12:06,320
land safely

1786
01:12:09,590 --> 01:12:07,920
all right thanks rob i have some

1787
01:12:11,669 --> 01:12:09,600
questions for you a little later on but

1788
01:12:13,990 --> 01:12:11,679

we are heading back to swati mohan who

1789
01:12:16,149 --> 01:12:14,000
is part of the landing team she'll be

1790
01:12:18,229 --> 01:12:16,159
calling out key milestone and events as

1791
01:12:22,790 --> 01:12:18,239
they happen from mission control so

1792
01:12:26,950 --> 01:12:24,709
so right now we're still about 20

1793
01:12:30,550 --> 01:12:26,960
minutes from entry and the edl phase is

1794
01:12:32,470 --> 01:12:30,560
giving a last-minute um

1795
01:12:34,470 --> 01:12:32,480
confirmation of what will be

1796
01:12:36,390 --> 01:12:34,480
happening

1797
01:12:38,550 --> 01:12:36,400
in the upcoming

1798
01:12:41,350 --> 01:12:38,560
changes to the vehicle just to remind

1799
01:12:44,229 --> 01:12:42,070
and

1800
01:12:45,830 --> 01:12:44,239
this will allow us to steer our

1801
01:12:47,350 --> 01:12:45,840
trajectory

1802
01:12:49,110 --> 01:12:47,360
as we make our way through the

1803
01:12:50,709 --> 01:12:49,120
atmosphere

1804
01:12:53,990 --> 01:12:50,719
and

1805
01:12:56,790 --> 01:12:54,000
this is one of the things that allowed

1806
01:12:58,870 --> 01:12:56,800
msl the curiosity rover

1807
01:13:02,390 --> 01:12:58,880
to

1808
01:13:04,870 --> 01:13:02,400
and we're depending on the same type of

1809
01:13:08,950 --> 01:13:04,880
entry guidance this time around

1810
01:13:12,709 --> 01:13:10,790
as we make our way

1811
01:13:15,030 --> 01:13:12,719
through entry finish the

1812
01:13:16,870 --> 01:13:15,040
finish our guided entry

1813
01:13:19,189 --> 01:13:16,880

profile

1814
01:13:21,030 --> 01:13:19,199
we'll do a maneuver called heading

1815
01:13:22,229 --> 01:13:21,040
alignment where we point toward the

1816
01:13:24,149 --> 01:13:22,239
target

1817
01:13:25,910 --> 01:13:24,159
and get ready to

1818
01:13:31,430 --> 01:13:25,920
deploy the parachute

1819
01:13:33,590 --> 01:13:31,440
we need to get rid of a

1820
01:13:35,270 --> 01:13:33,600
set of balanced passes

1821
01:13:36,790 --> 01:13:35,280
that have been

1822
01:13:39,990 --> 01:13:36,800
giving us a

1823
01:13:42,550 --> 01:13:40,000
center of gravity or cg offset

1824
01:13:44,070 --> 01:13:42,560
throughout the guided entry phase

1825
01:13:45,030 --> 01:13:44,080
so these are called

1826
01:13:49,430 --> 01:13:45,040
the

1827
01:13:52,229 --> 01:13:49,440
this maneuver

1828
01:13:53,430 --> 01:13:52,239
sucker sufr or straighten up and fly

1829
01:13:56,709 --> 01:13:53,440
right

1830
01:13:58,229 --> 01:13:56,719
so we'll go ahead and eject those masses

1831
01:14:01,110 --> 01:13:58,239
when we get

1832
01:14:03,270 --> 01:14:01,120
a trigger from the gnc system

1833
01:14:05,430 --> 01:14:03,280
telling us that we're at the appropriate

1834
01:14:07,750 --> 01:14:05,440
range to the target to do so

1835
01:14:09,430 --> 01:14:07,760
as soon as we deploy those

1836
01:14:12,070 --> 01:14:09,440
we will

1837
01:14:14,229 --> 01:14:12,080
no longer have a cd offset

1838
01:14:21,270 --> 01:14:14,239

and we'll be ready to deploy the

1839
01:14:24,229 --> 01:14:23,030
right where the perseverance team is

1840
01:14:26,830 --> 01:14:24,239
sitting now

1841
01:14:30,229 --> 01:14:26,840
what's in store for them as we approach

1842
01:14:32,390 --> 01:14:30,239
landing i'm gonna hold here for uh pdf

1843
01:14:35,430 --> 01:14:32,400
prep as uh we're about to start that

1844
01:14:39,110 --> 01:14:37,590
copy piece two

1845
01:14:40,870 --> 01:14:39,120
and activity please call that out when

1846
01:14:57,830 --> 01:14:40,880
it's ready

1847
01:15:01,189 --> 01:14:58,709
all right

1848
01:15:03,590 --> 01:15:01,199
now rob uh you've been right where the

1849
01:15:05,750 --> 01:15:03,600
perseverance team is sitting now uh

1850
01:15:07,030 --> 01:15:05,760
what's in store for them as we approach

1851
01:15:08,709 --> 01:15:07,040
landing

1852
01:15:11,189 --> 01:15:08,719
well this is the

1853
01:15:12,709 --> 01:15:11,199
this is the nail biting time um

1854
01:15:14,709 --> 01:15:12,719
fortunately we still have ones and zeros

1855
01:15:17,350 --> 01:15:14,719
coming but very soon as we approach true

1856
01:15:19,030 --> 01:15:17,360
stage separation the the transmitter on

1857
01:15:20,390 --> 01:15:19,040
this rover that's been we've been using

1858
01:15:22,470 --> 01:15:20,400
all the way to get to mars is going to

1859
01:15:24,229 --> 01:15:22,480
be turned off

1860
01:15:25,669 --> 01:15:24,239
um so

1861
01:15:27,270 --> 01:15:25,679
and we will lose our ability to see ones

1862
01:15:28,630 --> 01:15:27,280
and zeros but the good thing is once the

1863
01:15:31,590 --> 01:15:28,640

cruise stage is gone there's another

1864
01:15:32,709 --> 01:15:31,600
radio that will continue transmitting uh

1865
01:15:34,470 --> 01:15:32,719
a tone

1866
01:15:35,990 --> 01:15:34,480
so that like like a flashlight that will

1867
01:15:38,470 --> 01:15:36,000
allow us to see at least see that the

1868
01:15:39,990 --> 01:15:38,480
vehicle is still on and that and that

1869
01:15:41,510 --> 01:15:40,000
color of that flashlight tells us a

1870
01:15:44,149 --> 01:15:41,520
little bit with what state this the

1871
01:15:46,310 --> 01:15:44,159
rover is in but soon after that um it

1872
01:15:48,470 --> 01:15:46,320
won't be very long before we'll be able

1873
01:15:50,630 --> 01:15:48,480
to hear more ones and zeros coming from

1874
01:15:52,070 --> 01:15:50,640
the spacecraft um so this is a really

1875
01:15:54,390 --> 01:15:52,080
exciting time and and it's just

1876
01:15:55,750 --> 01:15:54,400
important to remind people this is a uh

1877
01:15:57,110 --> 01:15:55,760
there's a lot that can go wrong in a

1878
01:15:58,470 --> 01:15:57,120
date like today there's there are

1879
01:15:59,669 --> 01:15:58,480
thousands of things that have to go

1880
01:16:02,070 --> 01:15:59,679
right

1881
01:16:04,390 --> 01:16:02,080
yeah we had success in the past landing

1882
01:16:06,390 --> 01:16:04,400
on mars you think it gets easier but it

1883
01:16:09,030 --> 01:16:06,400
really doesn't why is it still so

1884
01:16:10,630 --> 01:16:09,040
difficult well it's well because it's

1885
01:16:12,149 --> 01:16:10,640
involved thousands and thousands of

1886
01:16:15,430 --> 01:16:12,159
things hundreds of thousands of lines of

1887
01:16:17,590 --> 01:16:15,440
code we there there is uh there's 79

1888
01:16:18,709 --> 01:16:17,600

pyrotechnic devices each have to work

1889
01:16:21,990 --> 01:16:18,719
perfectly

1890
01:16:24,070 --> 01:16:22,000
one critical wire short or one key thing

1891
01:16:26,470 --> 01:16:24,080
mechanism that doesn't work or breaks

1892
01:16:28,149 --> 01:16:26,480
and it's mission over and so it's you

1893
01:16:29,990 --> 01:16:28,159
know and and so

1894
01:16:33,270 --> 01:16:30,000
and it's very easy we're human beings

1895
01:16:35,990 --> 01:16:33,280
we're not perfect mistakes can be made

1896
01:16:39,030 --> 01:16:36,000
we each count on each other to to find

1897
01:16:41,350 --> 01:16:39,040
uh our own mistakes and and we

1898
01:16:43,990 --> 01:16:41,360
work very hard to to

1899
01:16:45,750 --> 01:16:44,000
learn from the mistakes of the past um

1900
01:16:46,630 --> 01:16:45,760
we've had many failures half remind

1901
01:16:48,070 --> 01:16:46,640
people

1902
01:16:50,630 --> 01:16:48,080
roughly half little

1903
01:16:53,990 --> 01:16:50,640
around half of the missions to mars over

1904
01:16:55,510 --> 01:16:54,000
history have failed um and so it's it's

1905
01:16:57,270 --> 01:16:55,520
it's that could happen today too even

1906
01:16:59,430 --> 01:16:57,280
though we've had a nice wonderful string

1907
01:17:00,550 --> 01:16:59,440
of successes in the united states it's

1908
01:17:05,110 --> 01:17:00,560
still

1909
01:17:07,110 --> 01:17:05,120
that we've we have hoped that we have we

1910
01:17:09,510 --> 01:17:07,120
have aired in the side of luck

1911
01:17:12,310 --> 01:17:09,520
and and and we've stacked the dice that

1912
01:17:15,030 --> 01:17:12,320
stacked the deck and uh loaded the dice

1913
01:17:17,510 --> 01:17:15,040

to make this thing succeed um but um if

1914
01:17:18,790 --> 01:17:17,520
we do if we do fail and something bad

1915
01:17:20,390 --> 01:17:18,800
happens today

1916
01:17:22,229 --> 01:17:20,400
i can tell you we're going to learn it

1917
01:17:23,990 --> 01:17:22,239
we'll have the data that tell us what

1918
01:17:24,709 --> 01:17:24,000
happened we'll know why we'll figure it

1919
01:17:26,630 --> 01:17:24,719
out

1920
01:17:28,709 --> 01:17:26,640
and and if we

1921
01:17:31,270 --> 01:17:28,719
are allowed we will pick ourselves up

1922
01:17:33,350 --> 01:17:31,280
and get us back on the horse and if

1923
01:17:34,390 --> 01:17:33,360
congress and nasa allow we will try

1924
01:17:36,149 --> 01:17:34,400
again

1925
01:17:37,350 --> 01:17:36,159
as we always do we will learn from our

1926
01:17:40,070 --> 01:17:37,360
mistakes

1927
01:17:42,070 --> 01:17:40,080
and what are the possible scenarios we

1928
01:17:43,110 --> 01:17:42,080
could be looking at today

1929
01:17:44,950 --> 01:17:43,120
well there's

1930
01:17:46,870 --> 01:17:44,960
things things like uh

1931
01:17:49,510 --> 01:17:46,880
one of the key stressful elements for

1932
01:17:51,030 --> 01:17:49,520
all of us is parachute inflation uh but

1933
01:17:52,950 --> 01:17:51,040
just even separating from the cruise

1934
01:17:55,189 --> 01:17:52,960
stage is a pretty major event lots of

1935
01:17:57,270 --> 01:17:55,199
devices have to work properly um

1936
01:17:58,950 --> 01:17:57,280
certainly on the heat shield separation

1937
01:18:00,950 --> 01:17:58,960
uh getting getting the the descent

1938
01:18:02,070 --> 01:18:00,960

engine started there's no less than than

1939
01:18:03,189 --> 01:18:02,080
uh

1940
01:18:05,750 --> 01:18:03,199
16

1941
01:18:07,830 --> 01:18:05,760
rocket motors that have to work one two

1942
01:18:10,149 --> 01:18:07,840
eight to control during entry another

1943
01:18:11,990 --> 01:18:10,159
eight to control it during landing i

1944
01:18:14,070 --> 01:18:12,000
said it's a lot of stuff and it all has

1945
01:18:16,709 --> 01:18:14,080
to work and guess what we haven't done

1946
01:18:19,110 --> 01:18:16,719
this before with this vehicle ever this

1947
01:18:21,590 --> 01:18:19,120
is this first attempt to actually land

1948
01:18:23,189 --> 01:18:21,600
we can't try this on earth we can't do

1949
01:18:25,350 --> 01:18:23,199
we don't have test pilots to try it out

1950
01:18:26,630 --> 01:18:25,360
on this planet before the big show so

1951
01:18:27,990 --> 01:18:26,640
this vehicle is doing it for the first

1952
01:18:30,229 --> 01:18:28,000
time we've done the best testing we can

1953
01:18:32,870 --> 01:18:30,239
do in bits and pieces but you know it's

1954
01:18:34,870 --> 01:18:32,880
it's as best as we could do and and uh

1955
01:18:37,030 --> 01:18:34,880
but i think our team is up to it we've

1956
01:18:39,350 --> 01:18:37,040
this team is the best it's a diverse

1957
01:18:40,790 --> 01:18:39,360
intelligent amazing group of people

1958
01:18:42,229 --> 01:18:40,800
people from all over the world who

1959
01:18:44,149 --> 01:18:42,239
worked on this not just here in

1960
01:18:46,709 --> 01:18:44,159
california but all over nasa

1961
01:18:49,110 --> 01:18:46,719
contributors from aerospace universities

1962
01:18:50,709 --> 01:18:49,120
countries around the world it is just an

1963
01:18:52,630 --> 01:18:50,719

incredible remarkable engineering

1964
01:18:54,470 --> 01:18:52,640
achievement and i am just so proud of

1965
01:18:56,709 --> 01:18:54,480
this team

1966
01:19:00,470 --> 01:18:56,719
thanks rob now let's listen back into

1967
01:19:05,030 --> 01:19:03,750
right you're about 14 minutes from entry

1968
01:19:06,709 --> 01:19:05,040
interface

1969
01:19:09,270 --> 01:19:06,719
the vehicle is

1970
01:19:11,669 --> 01:19:09,280
currently preparing the heat rejection

1971
01:19:13,110 --> 01:19:11,679
system that has kept the thermal system

1972
01:19:14,870 --> 01:19:13,120
cool inside the aeroshell for about the

1973
01:19:17,270 --> 01:19:14,880
last six months this will allow the

1974
01:19:19,430 --> 01:19:17,280
spacecraft to more easily cut the line

1975
01:19:28,070 --> 01:19:19,440
in upcoming cruise stage separation

1976
01:19:28,080 --> 01:19:33,750
we have now enabled the rover pyrobus

1977
01:19:38,310 --> 01:19:36,310
that's the pyrotechnic uh system uh that

1978
01:19:39,990 --> 01:19:38,320
that was powering off the cruise stage

1979
01:19:41,270 --> 01:19:40,000
devices

1980
01:19:42,870 --> 01:19:41,280
and these are the these are the things

1981
01:19:44,630 --> 01:19:42,880
in the cruise stage that will that we no

1982
01:19:46,870 --> 01:19:44,640
longer need with the pirate ticket

1983
01:19:49,030 --> 01:19:46,880
system working we can you can we can

1984
01:19:51,750 --> 01:19:49,040
explode the devices preparing for the

1985
01:19:54,310 --> 01:19:51,760
upcoming cruise stage duration in about

1986
01:19:56,790 --> 01:19:54,320
3 minutes 15 seconds

1987
01:19:58,470 --> 01:19:56,800
by powering off all the devices on the

1988
01:20:01,110 --> 01:19:58,480

cruise stage in order to

1989
01:20:05,510 --> 01:20:01,120
take me safe once the cruise stage is

1990
01:20:10,070 --> 01:20:07,910
yeah this is a this is a this tree stage

1991
01:20:12,709 --> 01:20:10,080
has been very reliable

1992
01:20:15,750 --> 01:20:12,719
we are firing our first pyros to event

1993
01:20:17,430 --> 01:20:15,760
the hrs liquid and gas

1994
01:20:18,870 --> 01:20:17,440
ah this has been the coolant because we

1995
01:20:20,709 --> 01:20:18,880
kept their vehicle from getting too hot

1996
01:20:25,830 --> 01:20:20,719
in the way of mars

1997
01:20:29,750 --> 01:20:28,229
and so this is one of the first uh major

1998
01:20:30,830 --> 01:20:29,760
events that take place as part of entry

1999
01:20:34,550 --> 01:20:30,840
descent

2000
01:20:36,229 --> 01:20:34,560
landing the transvent acre is complete

2001
01:20:41,590 --> 01:20:36,239
we will see the next anchor in

2002
01:20:46,629 --> 01:20:43,750
okay we are currently 12 and a half

2003
01:20:48,629 --> 01:20:46,639
minutes from entry interface we are

2004
01:20:53,030 --> 01:20:48,639
coming up on cruise stage separation in

2005
01:20:56,950 --> 01:20:55,189
what's happening now rob

2006
01:20:58,149 --> 01:20:56,960
okay we'll just we're just waiting the

2007
01:21:00,470 --> 01:20:58,159
the

2008
01:21:01,910 --> 01:21:00,480
rover is completely in charge it's doing

2009
01:21:03,350 --> 01:21:01,920
all the things we've taught it how to do

2010
01:21:05,669 --> 01:21:03,360
it's all built into the software we've

2011
01:21:08,790 --> 01:21:05,679
tested it over and over and over again

2012
01:21:11,350 --> 01:21:08,800
this team has spent 24 hours a day seven

2013
01:21:13,910 --> 01:21:11,360

days a week testing this thing for years

2014
01:21:15,990 --> 01:21:13,920
and and and so this is uh this is really

2015
01:21:18,229 --> 01:21:16,000
the culmination of all that work so this

2016
01:21:20,070 --> 01:21:18,239
vehicle is is gonna is getting ready to

2017
01:21:22,950 --> 01:21:20,080
push that cruise stage away

2018
01:21:25,189 --> 01:21:22,960
uh once it gets pushed away um it it

2019
01:21:27,270 --> 01:21:25,199
the entry system the rover inside with

2020
01:21:29,830 --> 01:21:27,280
the rover is still in charge is going to

2021
01:21:32,310 --> 01:21:29,840
get ready to take the vehicle turn it to

2022
01:21:34,950 --> 01:21:32,320
the right orientation and aim it to mars

2023
01:21:40,550 --> 01:21:34,960
and and uh and prepare for entering the

2024
01:21:44,310 --> 01:21:42,629
this won't be long

2025
01:21:46,629 --> 01:21:44,320
um be prepared for this event taking

2026
01:21:49,750 --> 01:21:46,639
about a minute and a half from mistake

2027
01:21:53,110 --> 01:21:49,760
separation about 11 minutes 20 seconds

2028
01:21:57,030 --> 01:21:55,350
okay so it's about 10 minutes from

2029
01:21:59,030 --> 01:21:57,040
cruising separation until it enters the

2030
01:22:02,229 --> 01:21:59,040
top of the atmosphere from then on and

2031
01:22:02,239 --> 01:22:05,990
telemetry will have stopped

2032
01:22:10,149 --> 01:22:07,590
telecom is confirming that the

2033
01:22:12,950 --> 01:22:10,159
spacecraft has switched to broadcasting

2034
01:22:15,430 --> 01:22:12,960
tones these tones are received directly

2035
01:22:16,950 --> 01:22:15,440
from perseverance but have very limited

2036
01:22:19,590 --> 01:22:16,960
information content

2037
01:22:22,470 --> 01:22:19,600
we won't receive real-time information

2038
01:22:24,390 --> 01:22:22,480

until about

2039
01:22:27,110 --> 01:22:24,400
9-10 minutes from now once the mars

2040
01:22:28,950 --> 01:22:27,120
reconnaissance orbiter starts relaying

2041
01:22:30,709 --> 01:22:28,960
information from perseverance

2042
01:22:32,790 --> 01:22:30,719
we are under a minute from cruise stage

2043
01:22:35,830 --> 01:22:32,800
separation about ten and a half minutes

2044
01:22:39,590 --> 01:22:37,750
it's getting exciting i have to admit i

2045
01:22:41,750 --> 01:22:39,600
am quite anxious

2046
01:22:42,950 --> 01:22:41,760
uh but very hopeful this machine is

2047
01:22:45,110 --> 01:22:42,960
going to do what we ask you're seeing

2048
01:22:46,950 --> 01:22:45,120
the heartbeat terms

2049
01:22:48,390 --> 01:22:46,960
okay that means that we there's no more

2050
01:22:59,750 --> 01:22:48,400
ones and zeros coming it's just the

2051
01:23:04,149 --> 01:23:01,669
we are continuing to receive tones from

2052
01:23:24,790 --> 01:23:04,159
perseverance coming standing by for

2053
01:23:28,390 --> 01:23:26,470
we have indication that cruise stage

2054
01:23:33,669 --> 01:23:28,400
separation has been confirmed by the

2055
01:23:37,830 --> 01:23:36,070
we're off on a good start in one minute

2056
01:23:39,669 --> 01:23:37,840
press advances landing software will

2057
01:23:42,629 --> 01:23:39,679
wake up and begin the no preparations

2058
01:23:45,110 --> 01:23:42,639
for entry the first action it will do is

2059
01:23:47,270 --> 01:23:45,120
to fire warm-up pulses with the entry

2060
01:23:49,350 --> 01:23:47,280
thrusters these pulses ensure that the

2061
01:23:51,189 --> 01:23:49,360
spacecraft gets the thrust that it wants

2062
01:23:52,310 --> 01:23:51,199
during entry interface

2063
01:23:59,510 --> 01:23:52,320

we're about

2064
01:24:02,950 --> 01:24:01,430
okay so now the vehicle's on its own

2065
01:24:04,709 --> 01:24:02,960
it's gonna it's turning itself into the

2066
01:24:06,149 --> 01:24:04,719
direction of facing the heat shield

2067
01:24:09,110 --> 01:24:06,159
toward mars

2068
01:24:10,709 --> 01:24:09,120
and uh and we'll eventually uh

2069
01:24:12,709 --> 01:24:10,719
uh hitting the top of the atmosphere

2070
01:24:20,870 --> 01:24:12,719
we're not far away this is gonna go very

2071
01:24:25,590 --> 01:24:22,790
that's confirmation that uh we got

2072
01:24:26,870 --> 01:24:25,600
shadowed by the crew stage

2073
01:24:31,350 --> 01:24:26,880
as it

2074
01:24:36,070 --> 01:24:33,590
telecom indicated actually that we could

2075
01:24:37,430 --> 01:24:36,080
see a signal that the crew stage went

2076
01:24:39,669 --> 01:24:37,440
between

2077
01:24:43,430 --> 01:24:39,679
the perseverance engine capsule and

2078
01:24:48,709 --> 01:24:45,590
the data stream indicating the crusade

2079
01:24:53,990 --> 01:24:50,870
we have confirmation that vehicle has

2080
01:25:03,590 --> 01:24:54,000
started warming up those entry thrusters

2081
01:25:09,270 --> 01:25:06,149
at this point the spacecraft is trying

2082
01:25:11,669 --> 01:25:09,280
to stop its spin from the cruise two

2083
01:25:13,430 --> 01:25:11,679
revolutions per minute down to zero

2084
01:25:15,910 --> 01:25:13,440
and then we'll turn to its desired

2085
01:25:17,189 --> 01:25:15,920
orientation from entry

2086
01:25:19,270 --> 01:25:17,199
it will

2087
01:25:21,189 --> 01:25:19,280
separate the two balanced maps that have

2088
01:25:22,709 --> 01:25:21,199

kept it balanced during all of cruise

2089
01:25:23,910 --> 01:25:22,719
this will allow the entry capsule to

2090
01:25:26,470 --> 01:25:23,920
have lift

2091
01:25:27,669 --> 01:25:26,480
when it enters the atmosphere we have

2092
01:25:30,149 --> 01:25:27,679
competition that

2093
01:25:32,550 --> 01:25:30,159
has turned to the desire

2094
01:25:34,070 --> 01:25:32,560
entry attitude

2095
01:25:39,350 --> 01:25:34,080
we are about seven and a half minutes

2096
01:25:42,629 --> 01:25:41,430
okay the vehicle is pointed in the right

2097
01:25:44,950 --> 01:25:42,639
direction

2098
01:25:46,070 --> 01:25:44,960
thrusters are warmed up and doing their

2099
01:25:47,350 --> 01:25:46,080
job

2100
01:25:49,669 --> 01:25:47,360
and now

2101
01:25:51,110 --> 01:25:49,679
we've spun down from the

2102
01:25:52,709 --> 01:25:51,120
two revolutions per minute that the

2103
01:25:55,270 --> 01:25:52,719
vehicle had the whole way to on the way

2104
01:25:57,189 --> 01:25:55,280
to mars is a spin stabilized spacecraft

2105
01:25:59,189 --> 01:25:57,199
and then from here on out it's going to

2106
01:26:01,189 --> 01:25:59,199
just be a bullet and it's going to

2107
01:26:03,990 --> 01:26:01,199
control its orient orientation and

2108
01:26:05,750 --> 01:26:04,000
attitude via rockets on the back of that

2109
01:26:06,830 --> 01:26:05,760
points carrier lock

2110
01:26:11,030 --> 01:26:06,840
yes sorry

2111
01:26:14,070 --> 01:26:11,040
camera dte from radio science from green

2112
01:26:20,629 --> 01:26:14,080
bank reports carrier lock

2113
01:26:25,030 --> 01:26:23,030

flight level one

2114
01:26:27,910 --> 01:26:25,040
we are continuing to wait for entry

2115
01:26:30,070 --> 01:26:27,920
interface for about six minutes and 45

2116
01:26:32,709 --> 01:26:30,080
seconds from entry interface

2117
01:26:35,110 --> 01:26:32,719
we have confirmation from uh greenback

2118
01:26:37,270 --> 01:26:35,120
that they are receiving direct earth

2119
01:26:38,870 --> 01:26:37,280
telemetry via that

2120
01:26:39,830 --> 01:26:38,880
path

2121
01:26:42,149 --> 01:26:39,840
the

2122
01:26:44,229 --> 01:26:42,159
spacecraft performance is currently

2123
01:26:46,310 --> 01:26:44,239
transmitting heartbeat tones

2124
01:26:48,870 --> 01:26:46,320
these tones indicate that perseverance

2125
01:26:52,790 --> 01:26:48,880
is operating normally and has nothing

2126
01:26:56,550 --> 01:26:54,550
just as expected

2127
01:27:05,430 --> 01:26:56,560
we're currently just over six minutes

2128
01:27:13,910 --> 01:27:06,790
okay

2129
01:27:17,830 --> 01:27:15,189
as soon as we get to the top of the

2130
01:27:19,830 --> 01:27:17,840
atmosphere the atm will be very quickly

2131
01:27:22,709 --> 01:27:19,840
which is the entry point it won't be

2132
01:27:24,390 --> 01:27:22,719
very long before the the atmosphere will

2133
01:27:26,149 --> 01:27:24,400
start getting thicker and thicker it's

2134
01:27:28,070 --> 01:27:26,159
going very quickly at a at a fairly

2135
01:27:29,750 --> 01:27:28,080
steep angle of 15 degrees

2136
01:27:31,830 --> 01:27:29,760
into the atmosphere as it starts to slow

2137
01:27:33,510 --> 01:27:31,840
down just under

2138
01:27:35,030 --> 01:27:33,520

about five and a half minutes from entry

2139
01:27:37,510 --> 01:27:35,040
interface

2140
01:27:39,189 --> 01:27:37,520
we're still receiving heartbeat tones

2141
01:27:41,110 --> 01:27:39,199
we expect to continue receiving

2142
01:27:43,750 --> 01:27:41,120
heartbeat tones until about five minutes

2143
01:27:45,350 --> 01:27:43,760
after entry at that time perseverance

2144
01:27:47,350 --> 01:27:45,360
will be no longer in view of our

2145
01:27:50,390 --> 01:27:47,360
antennas here on earth

2146
01:27:52,629 --> 01:27:50,400
about 90 seconds prior to entry the mars

2147
01:27:55,030 --> 01:27:52,639
reconnaissance orbiter should begin

2148
01:27:57,110 --> 01:27:55,040
receiving telemetry from perseverance

2149
01:27:58,310 --> 01:27:57,120
and streaming it to earth in near real

2150
01:28:01,510 --> 01:27:58,320
time

2151
01:28:03,830 --> 01:28:01,520
there are a few expected short outages

2152
01:28:06,629 --> 01:28:03,840
such as when we have a plasma back out

2153
01:28:08,470 --> 01:28:06,639
or when we enter the peak heating phase

2154
01:28:10,709 --> 01:28:08,480
aside from these outages caused by the

2155
01:28:12,950 --> 01:28:10,719
plasma blackout antenna switching or

2156
01:28:15,189 --> 01:28:12,960
high dynamic events spacecraft events we

2157
01:28:16,149 --> 01:28:15,199
should have telemetry until about 90

2158
01:28:17,110 --> 01:28:16,159
seconds

2159
01:28:18,390 --> 01:28:17,120
after

2160
01:28:20,470 --> 01:28:18,400
landing

2161
01:28:22,149 --> 01:28:20,480
a prisma blackout

2162
01:28:24,950 --> 01:28:22,159
is

2163
01:28:27,510 --> 01:28:24,960

strong enough to make it through the

2164
01:28:29,510 --> 01:28:27,520
superheated super fast air flowing

2165
01:28:31,350 --> 01:28:29,520
around the spacecraft all the way down

2166
01:28:33,270 --> 01:28:31,360
to earth once the temperature drops

2167
01:28:35,189 --> 01:28:33,280
below that peak heating we do reacquire

2168
01:28:36,870 --> 01:28:35,199
the signal from perseverance

2169
01:28:39,590 --> 01:28:36,880
we are currently about four and a half

2170
01:28:41,189 --> 01:28:39,600
minutes from entry intervase

2171
01:28:43,430 --> 01:28:41,199
perseverance continues to report

2172
01:28:45,590 --> 01:28:43,440
heartbeat tones indicating everything is

2173
01:28:46,470 --> 01:28:45,600
nominal

2174
01:28:48,310 --> 01:28:46,480
okay

2175
01:28:50,310 --> 01:28:48,320
what we wait what we're looking for now

2176
01:28:53,110 --> 01:28:50,320
is where mars reconnaissance orbiter

2177
01:28:55,110 --> 01:28:53,120
should be in view soon of our vehicle

2178
01:28:57,110 --> 01:28:55,120
and be able to listen to ones and zeros

2179
01:28:58,390 --> 01:28:57,120
coming from a separate radio that's

2180
01:28:59,590 --> 01:28:58,400
really designed to talk between

2181
01:29:01,270 --> 01:28:59,600
spacecraft

2182
01:29:02,790 --> 01:29:01,280
camera reports the electro radio is

2183
01:29:04,709 --> 01:29:02,800
powered on ready to receive signals from

2184
01:29:07,189 --> 01:29:04,719
the lander okay

2185
01:29:09,590 --> 01:29:07,199
mro is ready and less enabled and

2186
01:29:11,510 --> 01:29:09,600
waiting for the to hear from our rover

2187
01:29:13,830 --> 01:29:11,520
constance's orbiter has reported that

2188
01:29:16,870 --> 01:29:13,840

it's ready to receive the signal from

2189
01:29:19,669 --> 01:29:16,880
perseverance it should be in a few

2190
01:29:26,470 --> 01:29:19,679
minutes here we're just flight local one

2191
01:29:29,510 --> 01:29:28,229
we don't need these ones and zeros as

2192
01:29:32,229 --> 01:29:29,520
swati said

2193
01:29:33,270 --> 01:29:32,239
but to land safely but we really need it

2194
01:29:34,149 --> 01:29:33,280
for our own

2195
01:29:35,669 --> 01:29:34,159
uh

2196
01:29:38,390 --> 01:29:35,679
health and well-being today to keep our

2197
01:29:40,709 --> 01:29:38,400
nerves in control around this time a

2198
01:29:42,790 --> 01:29:40,719
second spacecraft maven should begin

2199
01:29:44,550 --> 01:29:42,800
picking up telemetry from perseverance

2200
01:29:46,470 --> 01:29:44,560
and will continue to record that

2201
01:29:47,510 --> 01:29:46,480
telemetry until several minutes post

2202
01:29:50,229 --> 01:29:47,520
landing

2203
01:29:52,629 --> 01:29:50,239
we won't get that data for several hours

2204
01:29:55,990 --> 01:29:52,639
after landing as it's being recorded and

2205
01:29:58,070 --> 01:29:56,000
then will be forwarded to earth later

2206
01:30:00,229 --> 01:29:58,080
we are continuing to receive heartbeat

2207
01:30:02,950 --> 01:30:00,239
tones indicating that everything is

2208
01:30:06,790 --> 01:30:02,960
nominal we're currently at about three

2209
01:30:11,990 --> 01:30:06,800
minutes until entry interface

2210
01:30:26,629 --> 01:30:13,669
very soon we'll be getting ones and

2211
01:30:30,390 --> 01:30:28,550
the entry interface is nothing more than

2212
01:30:32,310 --> 01:30:30,400
just an arbitrary place in the sky that

2213
01:30:34,310 --> 01:30:32,320

we've defined to be above the atmosphere

2214
01:30:36,229 --> 01:30:34,320
but but from that point on uh there's

2215
01:30:37,990 --> 01:30:36,239
definitely uh

2216
01:30:39,590 --> 01:30:38,000
atmosphere and above it there isn't

2217
01:30:42,229 --> 01:30:39,600
there are two minutes from entry

2218
01:30:45,110 --> 01:30:42,239
interface criteria

2219
01:30:50,550 --> 01:30:45,120
will transmit heartbeat tones indicating

2220
01:30:53,590 --> 01:30:52,070
so the tones can tell us whether

2221
01:30:55,990 --> 01:30:53,600
something's bad or not is happening so

2222
01:30:57,990 --> 01:30:56,000
so far the heartbeat is is doing well so

2223
01:31:00,709 --> 01:30:58,000
the vehicle thinks it's help it's in

2224
01:31:18,070 --> 01:31:00,719
good shape to land

2225
01:31:22,629 --> 01:31:19,990
we're just under two minutes from entry

2226
01:31:24,470 --> 01:31:22,639
interface as it gets closer to mars

2227
01:31:27,270 --> 01:31:24,480
preservance is actually being pulled in

2228
01:31:28,830 --> 01:31:27,280
by gravity and accelerating by the time

2229
01:31:32,550 --> 01:31:28,840
price range reaches entry interface

2230
01:31:34,470 --> 01:31:32,560
point he should be going just under 5.4

2231
01:31:36,229 --> 01:31:34,480
kilometers per second

2232
01:31:38,870 --> 01:31:36,239
we had about

2233
01:31:40,790 --> 01:31:38,880
90 seconds from entry interface and

2234
01:31:42,310 --> 01:31:40,800
standing by for mars reconnaissance

2235
01:32:09,990 --> 01:31:42,320
orbiter to pick up

2236
01:32:10,000 --> 01:32:28,790
we are one minute from entry interface

2237
01:32:34,390 --> 01:32:32,149
mro is in receive mode

2238
01:32:37,030 --> 01:32:34,400

we have confirmation that the confidence

2239
01:32:38,470 --> 01:32:37,040
inspirator is now relaying data from

2240
01:32:40,470 --> 01:32:38,480
perseverance

2241
01:32:41,590 --> 01:32:40,480
we're about 30 seconds from entry

2242
01:32:44,070 --> 01:32:41,600
interface

2243
01:32:47,270 --> 01:32:44,080
programs is going about 5.2 kilometers

2244
01:32:49,830 --> 01:32:47,280
per second and is about 190 kilometers

2245
01:32:58,229 --> 01:32:49,840
altitude above the surface of mars

2246
01:33:04,870 --> 01:33:02,470
about seconds from entry interface

2247
01:33:05,990 --> 01:33:04,880
5.3 kilometers per second and an

2248
01:33:25,350 --> 01:33:06,000
altitude of

2249
01:33:29,510 --> 01:33:27,189
we have confirmation of

2250
01:33:32,550 --> 01:33:29,520
entry interface preservance is currently

2251
01:33:33,870 --> 01:33:32,560
going 5.3 kilometers per second at an

2252
01:33:45,030 --> 01:33:33,880
altitude of about

2253
01:33:49,030 --> 01:33:47,830
the secret is now waiting until it

2254
01:33:51,510 --> 01:33:49,040
begins

2255
01:33:54,310 --> 01:33:51,520
feeling the atmosphere

2256
01:33:56,790 --> 01:33:54,320
go down once there is enough atmosphere

2257
01:34:04,229 --> 01:33:56,800
it will start controlling its path to

2258
01:34:09,750 --> 01:34:06,870
navigation is also confirming that we

2259
01:34:11,350 --> 01:34:09,760
can see a little bit of that slowdown

2260
01:34:13,910 --> 01:34:11,360
of

2261
01:34:16,149 --> 01:34:13,920
the atmosphere on the perseverance entry

2262
01:34:20,070 --> 01:34:16,159
capsule

2263
01:34:21,990 --> 01:34:20,080

our current velocity is about 5.36

2264
01:34:23,750 --> 01:34:22,000
kilometers per second and an altitude of

2265
01:34:26,229 --> 01:34:23,760
about 67

2266
01:34:27,910 --> 01:34:26,239
kilometers from the surface

2267
01:34:39,030 --> 01:34:27,920
we are probably seeing mro plasma

2268
01:34:41,910 --> 01:34:40,629
the vehicle should be doing its turns

2269
01:34:45,030 --> 01:34:41,920
right now

2270
01:34:48,470 --> 01:34:45,040
cameron has lost luck

2271
01:34:51,430 --> 01:34:50,550
we have indications that perseverance is

2272
01:34:53,430 --> 01:34:51,440
now

2273
01:34:56,310 --> 01:34:53,440
performing bank reversals in the

2274
01:35:00,149 --> 01:34:56,320
atmosphere these are the steps in order

2275
01:35:01,669 --> 01:35:00,159
to control its distance to the landing

2276
01:35:03,910 --> 01:35:01,679
target

2277
01:35:06,070 --> 01:35:03,920
uh perseverance has just passed through

2278
01:35:09,669 --> 01:35:06,080
the point of maximum deceleration and

2279
01:35:10,709 --> 01:35:09,679
has indicated that it felt approximately

2280
01:35:13,470 --> 01:35:10,719
10

2281
01:35:17,350 --> 01:35:13,480
earth gs of deceleration

2282
01:35:21,910 --> 01:35:18,629
yes

2283
01:35:24,310 --> 01:35:21,920
we saw a small outage uh

2284
01:35:26,470 --> 01:35:24,320
of the uhf telemetry from mars

2285
01:35:27,750 --> 01:35:26,480
reconnaissance orbiter during that peak

2286
01:35:30,470 --> 01:35:27,760
heating phase

2287
01:35:32,149 --> 01:35:30,480
likely caused by the plasma blackout

2288
01:35:34,790 --> 01:35:32,159

perseverance is still continuing to

2289
01:35:36,629 --> 01:35:34,800
perform bank reversals in the atmosphere

2290
01:35:53,510 --> 01:35:36,639
to control

2291
01:35:57,430 --> 01:35:55,669
perseverance is going about one

2292
01:35:58,310 --> 01:35:57,440
kilometer per second

2293
01:36:00,550 --> 01:35:58,320
at

2294
01:36:02,470 --> 01:36:00,560
an altitude of about 16 kilometers from

2295
01:36:04,950 --> 01:36:02,480
the surface of mars

2296
01:36:07,189 --> 01:36:04,960
we have entered heading alignment

2297
01:36:09,189 --> 01:36:07,199
which means presidents is no longer

2298
01:36:10,550 --> 01:36:09,199
trying to control the distance to mars

2299
01:36:12,709 --> 01:36:10,560
but ends

2300
01:36:13,669 --> 01:36:12,719
to the target on mars but instead is

2301
01:36:23,990 --> 01:36:13,679
flying

2302
01:36:24,000 --> 01:36:46,470
periscope

2303
01:36:52,390 --> 01:36:49,790
our current velocity is about

2304
01:37:00,390 --> 01:36:52,400
550 meters per second and an altitude of

2305
01:37:00,400 --> 01:37:04,709
amaro is reporting good telemetry log

2306
01:37:09,270 --> 01:37:07,270
we are coming upon the straighten up

2307
01:37:10,709 --> 01:37:09,280
we are starting to straighten up and fly

2308
01:37:12,390 --> 01:37:10,719
right maneuver

2309
01:37:15,109 --> 01:37:12,400
where the spacecraft will jettison the

2310
01:37:17,109 --> 01:37:15,119
entry balance masses in preparation for

2311
01:37:18,629 --> 01:37:17,119
parachute deploy and to roll over to

2312
01:37:22,470 --> 01:37:18,639
give the radar a better look at the

2313
01:37:25,430 --> 01:37:23,270

yes

2314
01:37:27,189 --> 01:37:25,440
the navigation has confirmed that the

2315
01:37:29,430 --> 01:37:27,199
parachute has deployed and we are seeing

2316
01:37:31,510 --> 01:37:29,440
significant deceleration

2317
01:37:34,310 --> 01:37:31,520
in the velocity our current velocity is

2318
01:37:36,149 --> 01:37:34,320
450 meters per second at an altitude of

2319
01:37:47,189 --> 01:37:36,159
about 12 kilometers from the surface of

2320
01:37:50,950 --> 01:37:49,590
first advance is now slowed to subsonic

2321
01:37:53,350 --> 01:37:50,960
speeds and the heat shield has been

2322
01:37:55,030 --> 01:37:53,360
separated this allows

2323
01:37:57,350 --> 01:37:55,040
both the radar and the cameras to get

2324
01:38:00,310 --> 01:37:57,360
their first look at the surface current

2325
01:38:02,870 --> 01:38:00,320
velocity is 145 meters per second and an

2326
01:38:24,390 --> 01:38:02,880
altitude of about 10 km nine and a half

2327
01:38:24,400 --> 01:38:28,950
yes yes yes

2328
01:38:34,149 --> 01:38:31,350
now has radar lock on the ground current

2329
01:38:36,820 --> 01:38:34,159
velocity is about 100 meters per second

2330
01:38:40,950 --> 01:38:36,830
6.6 kilometers of the surface

2331
01:38:46,229 --> 01:38:42,950
perseverance is continuing to descend on

2332
01:38:48,070 --> 01:38:46,239
the parachute we are coming up on

2333
01:38:50,790 --> 01:38:48,080
the initialization of terrain relative

2334
01:38:52,149 --> 01:38:50,800
navigation and subsequently the priming

2335
01:38:55,350 --> 01:38:52,159
of the landing engines our current

2336
01:39:03,669 --> 01:38:55,360
velocity is about 90 meters per second

2337
01:39:06,709 --> 01:39:05,030
we have confirmation that the lander

2338
01:39:08,790 --> 01:39:06,719

vision system has produced a valid

2339
01:39:13,109 --> 01:39:08,800
solution and part of training relative

2340
01:39:13,119 --> 01:39:21,590
we have timing of the landing engines

2341
01:39:27,590 --> 01:39:24,550
current velocity is 83 meters per second

2342
01:39:29,590 --> 01:39:27,600
at about 2.6 kilometers from the surface

2343
01:39:31,350 --> 01:39:29,600
mars we have confirmation that the back

2344
01:39:33,030 --> 01:39:31,360
shell has separated

2345
01:39:35,510 --> 01:39:33,040
we are currently performing the divert

2346
01:39:37,830 --> 01:39:35,520
maneuver current velocity is about 75

2347
01:39:39,590 --> 01:39:37,840
meters per second at an altitude of

2348
01:39:40,950 --> 01:39:39,600
about a kilometer off the surface of

2349
01:39:43,910 --> 01:39:40,960
mars

2350
01:39:45,990 --> 01:39:43,920
here in safety bravo

2351
01:39:47,430 --> 01:39:46,000
we have completed our terrain relative

2352
01:39:48,950 --> 01:39:47,440
navigation

2353
01:39:50,950 --> 01:39:48,960
current speed is about

2354
01:40:02,470 --> 01:39:50,960
30 meters per second altitude of about

2355
01:40:06,709 --> 01:40:04,790
we have started our constant velocity

2356
01:40:08,629 --> 01:40:06,719
accordion which means we are conducting

2357
01:40:10,950 --> 01:40:08,639
the sky crane

2358
01:40:14,390 --> 01:40:10,960
about to conduct the cycling maneuver

2359
01:40:15,910 --> 01:40:14,400
we've lost direct to earth to tones

2360
01:40:21,189 --> 01:40:15,920
as expected

2361
01:40:21,199 --> 01:40:31,750
about 20 meters off the surface

2362
01:40:31,760 --> 01:40:43,370
we're getting signals from mro

2363
01:40:52,200 --> 01:40:45,610

[Music]

2364
01:40:55,970 --> 01:40:52,660
[Applause]

2365
01:41:01,270 --> 01:40:55,980
[Music]

2366
01:41:05,910 --> 01:41:02,149
since

2367
01:41:07,189 --> 01:41:05,920
perseverance is continuing to transmit

2368
01:41:11,580 --> 01:41:07,199
direct

2369
01:41:22,390 --> 01:41:11,590
through marzipan orbiter to earth

2370
01:41:24,709 --> 01:41:22,400
[Applause]

2371
01:41:28,550 --> 01:41:24,719
oh my god

2372
01:41:35,189 --> 01:41:30,790
my gosh still getting telemetry from the

2373
01:41:39,189 --> 01:41:37,750
all right all stations

2374
01:41:41,830 --> 01:41:39,199
we got it

2375
01:41:44,229 --> 01:41:41,840
we're gonna wait for the images

2376
01:41:46,709 --> 01:41:44,239
wow this is so exciting

2377
01:41:49,030 --> 01:41:46,719
the team is beside themselves

2378
01:42:06,870 --> 01:41:49,040
it's so surreal stay tuned we might get

2379
01:42:06,880 --> 01:42:12,470
so much has been riding on this

2380
01:42:17,750 --> 01:42:14,870
yet we just heard the news that

2381
01:42:21,590 --> 01:42:17,760
perseverance is alive on the surface of

2382
01:42:24,390 --> 01:42:23,350
it's not uh

2383
01:42:25,910 --> 01:42:24,400
flight

2384
01:42:28,310 --> 01:42:25,920
despite we have seen the completion of

2385
01:42:39,510 --> 01:42:28,320
edl 3000

2386
01:42:44,450 --> 01:42:41,109
amarillo is still seeing a strong signal

2387
01:42:44,460 --> 01:42:56,950
[Applause]

2388
01:43:01,350 --> 01:42:58,310

we have just heard the news that

2389
01:43:04,870 --> 01:43:01,360
perseverance is alive on the surface of

2390
01:43:06,070 --> 01:43:04,880
mars congratulations to the mission

2391
01:43:07,590 --> 01:43:06,080
and

2392
01:43:11,109 --> 01:43:07,600
looks like we have some more news in it

2393
01:43:16,870 --> 01:43:11,119
looks like we're getting the first image

2394
01:43:22,830 --> 01:43:20,070
this is ol3 i have

2395
01:43:47,430 --> 01:43:22,840
the target point on the map when you are

2396
01:44:00,149 --> 01:43:50,229
flight i'll be uh moving in showing you

2397
01:44:04,629 --> 01:44:02,229
the team has just put the first image

2398
01:44:06,709 --> 01:44:04,639
from perseverance on the surface of mars

2399
01:44:09,910 --> 01:44:06,719
now it comes from the engineering

2400
01:44:11,990 --> 01:44:09,920
cameras known as the hazard camera this

2401
01:44:14,709 --> 01:44:12,000
camera is mainly used to help the rover

2402
01:44:16,790 --> 01:44:14,719
drive safely around mars and we will get

2403
01:44:27,990 --> 01:44:16,800
higher resolution photos later in the

2404
01:44:28,000 --> 01:44:46,709
this is amazing

2405
01:44:46,719 --> 01:44:54,400
stand by for steve

2406
01:45:05,510 --> 01:45:00,270
[Music]

2407
01:45:05,520 --> 01:45:32,070
you did you led the team

2408
01:45:36,629 --> 01:45:34,790
we just got our second image in

2409
01:45:39,030 --> 01:45:36,639
our second image

2410
01:45:40,870 --> 01:45:39,040
is in

2411
01:45:42,950 --> 01:45:40,880
okay this these these we have a camera

2412
01:45:45,750 --> 01:45:42,960
in the front and out rear the the

2413
01:45:46,870 --> 01:45:45,760

spacecraft uh it's uh it's it's they're

2414
01:45:49,030 --> 01:45:46,880
near the ground so these are pretty

2415
01:45:51,030 --> 01:45:49,040
close you can see the wheels there uh

2416
01:45:53,109 --> 01:45:51,040
and and and they're a little dirty

2417
01:45:55,830 --> 01:45:53,119
because you've got glass covers over

2418
01:45:57,510 --> 01:45:55,840
these these cameras but uh we took these

2419
01:45:58,950 --> 01:45:57,520
seconds after landing so so there's

2420
01:46:03,030 --> 01:45:58,960
still dust in the air from our landing

2421
01:46:04,950 --> 01:46:03,040
event uh so this is this is happening um

2422
01:46:06,149 --> 01:46:04,960
you know this happened just seconds ago

2423
01:46:06,950 --> 01:46:06,159
just arrived

2424
01:46:09,750 --> 01:46:06,960
and

2425
01:46:11,990 --> 01:46:09,760
this is really amazing

2426
01:46:13,430 --> 01:46:12,000
and uh we even know where we landed this

2427
01:46:15,430 --> 01:46:13,440
is the most amazing thing the vehicle

2428
01:46:17,910 --> 01:46:15,440
has told us where it's landed because

2429
01:46:20,950 --> 01:46:17,920
figured it out you know this is a sign

2430
01:46:22,870 --> 01:46:20,960
nasa works nasa works and when we put

2431
01:46:24,390 --> 01:46:22,880
our arms together and our hands together

2432
01:46:26,870 --> 01:46:24,400
and our brains together

2433
01:46:29,270 --> 01:46:26,880
we can succeed this is what nasa does

2434
01:46:31,189 --> 01:46:29,280
this is what we can do as a country on

2435
01:46:33,189 --> 01:46:31,199
all of the problems we we have we need

2436
01:46:43,760 --> 01:46:33,199
to work together to do these kinds of

2437
01:46:47,669 --> 01:46:45,830
[Music]

2438
01:46:50,229 --> 01:46:47,679

joining us now

2439
01:46:52,870 --> 01:46:50,239
is the acting administrator of nasa

2440
01:46:55,109 --> 01:46:52,880
steve jurisic steve welcome and

2441
01:46:58,470 --> 01:46:55,119
congratulations

2442
01:47:01,030 --> 01:46:58,480
hey thank you what an amazing day

2443
01:47:02,310 --> 01:47:01,040
how does it feel to have another rover

2444
01:47:04,629 --> 01:47:02,320
on mars

2445
01:47:07,510 --> 01:47:04,639
uh it's amazing um

2446
01:47:09,189 --> 01:47:07,520
uh to have perseverance join curiosity

2447
01:47:11,669 --> 01:47:09,199
on mars and

2448
01:47:13,990 --> 01:47:11,679
what what a just a credit to the team i

2449
01:47:14,870 --> 01:47:14,000
mean just what an amazing team

2450
01:47:18,070 --> 01:47:14,880
um

2451
01:47:19,830 --> 01:47:18,080
to work through all the adversity

2452
01:47:22,950 --> 01:47:19,840
that goes and all the challenges that go

2453
01:47:26,149 --> 01:47:22,960
with landing a rover on mars plus the

2454
01:47:27,990 --> 01:47:26,159
challenges of covid and um and just an

2455
01:47:28,790 --> 01:47:28,000
amazing accomplishment

2456
01:47:32,629 --> 01:47:28,800
and

2457
01:47:34,790 --> 01:47:32,639
future plans

2458
01:47:37,830 --> 01:47:34,800
so for robotic exploration know every

2459
01:47:40,550 --> 01:47:37,840
time we uh execute a mission with new

2460
01:47:42,149 --> 01:47:40,560
instruments we discover new things and

2461
01:47:44,390 --> 01:47:42,159
things we never thought we would

2462
01:47:46,390 --> 01:47:44,400
discover so that's that always informs

2463
01:47:49,669 --> 01:47:46,400

our future robotic missions

2464
01:47:52,629 --> 01:47:49,679
both landers rovers and orbiters

2465
01:47:54,550 --> 01:47:52,639
this mission also has technology on it

2466
01:47:58,149 --> 01:47:54,560
one of the cool things is the ingenuity

2467
01:48:00,310 --> 01:47:58,159
helicopter um it's an experiment on this

2468
01:48:02,470 --> 01:48:00,320
mission but if it's successful we can

2469
01:48:03,830 --> 01:48:02,480
use it as an observation science

2470
01:48:06,149 --> 01:48:03,840
observation platform by putting

2471
01:48:07,510 --> 01:48:06,159
instruments on it and also use it as a

2472
01:48:10,070 --> 01:48:07,520
scout

2473
01:48:12,310 --> 01:48:10,080
for future rover missions

2474
01:48:15,669 --> 01:48:12,320
and uh and then just the entry center

2475
01:48:16,790 --> 01:48:15,679
landing um capability um it'll allow us

2476
01:48:19,669 --> 01:48:16,800
to land

2477
01:48:21,750 --> 01:48:19,679
more and more larger more ambitious

2478
01:48:23,910 --> 01:48:21,760
robots on the surface of mars and then

2479
01:48:26,950 --> 01:48:23,920
for human exploration

2480
01:48:28,550 --> 01:48:26,960
um we have the medley

2481
01:48:30,070 --> 01:48:28,560
mars intercept landing instrumentation

2482
01:48:31,510 --> 01:48:30,080
which is going to give us edl

2483
01:48:33,910 --> 01:48:31,520
information

2484
01:48:36,709 --> 01:48:33,920
we have the mars environmental dynamics

2485
01:48:39,030 --> 01:48:36,719
analyzer it's going to give us uh

2486
01:48:40,709 --> 01:48:39,040
properties size and properties of dust

2487
01:48:41,830 --> 01:48:40,719
particles because when we send people

2488
01:48:43,510 --> 01:48:41,840

we're going to have to deal with that

2489
01:48:45,270 --> 01:48:43,520
dust

2490
01:48:46,709 --> 01:48:45,280
and just it's just this is just an

2491
01:48:49,430 --> 01:48:46,719
incredible mission because of the

2492
01:48:51,590 --> 01:48:49,440
science and the technology and then

2493
01:48:52,470 --> 01:48:51,600
caching samples for a mars sample return

2494
01:48:57,910 --> 01:48:52,480
mission

2495
01:48:59,430 --> 01:48:57,920
first round trip to mars and back and

2496
01:49:01,590 --> 01:48:59,440
bringing the samples cached by

2497
01:49:04,070 --> 01:49:01,600
perseverance back to earth to

2498
01:49:05,590 --> 01:49:04,080
examine with state-of-the-art

2499
01:49:06,950 --> 01:49:05,600
equipment in our laboratories here on

2500
01:49:09,750 --> 01:49:06,960
earth

2501
01:49:11,910 --> 01:49:09,760
we have so much to look forward to

2502
01:49:16,550 --> 01:49:11,920
and we also have a student question

2503
01:49:21,589 --> 01:49:18,709
hi my name is landon applegate i'm in

2504
01:49:24,149 --> 01:49:21,599
sixth grade and i'm going to academy for

2505
01:49:26,229 --> 01:49:24,159
academic excellence and my question is

2506
01:49:28,550 --> 01:49:26,239
do you think we could get resources from

2507
01:49:31,830 --> 01:49:28,560
mars to help on future missions or even

2508
01:49:34,149 --> 01:49:31,840
as like a launching point

2509
01:49:36,629 --> 01:49:34,159
great question land and actually we have

2510
01:49:37,669 --> 01:49:36,639
an experiment called the mox the mars

2511
01:49:39,990 --> 01:49:37,679
oxygen

2512
01:49:42,790 --> 01:49:40,000
in situ resource utilization experiment

2513
01:49:46,709 --> 01:49:42,800

or moxie and it's going to demonstrate

2514
01:49:49,830 --> 01:49:46,719
generating oxygen from atmospheric co2

2515
01:49:51,990 --> 01:49:49,840
and that could help generate you know

2516
01:49:54,470 --> 01:49:52,000
generate breathable oxygen and even if

2517
01:49:56,950 --> 01:49:54,480
we can liquefy it oxidizer for

2518
01:49:59,109 --> 01:49:56,960
propulsion systems so that's a tech demo

2519
01:50:01,270 --> 01:49:59,119
on perseverance and then we're going to

2520
01:50:05,589 --> 01:50:01,280
continue to characterize the frozen

2521
01:50:07,430 --> 01:50:05,599
water on and below the surface of mars

2522
01:50:09,990 --> 01:50:07,440
and eventually try to figure out how to

2523
01:50:12,310 --> 01:50:10,000
extract that water from the martian soil

2524
01:50:15,030 --> 01:50:12,320
or we call regolith and then we can use

2525
01:50:17,750 --> 01:50:15,040
that for potable water and also break it

2526
01:50:20,070 --> 01:50:17,760
down into oxygen and hydrogen for rocket

2527
01:50:21,990 --> 01:50:20,080
fuel so absolutely we're going to try to

2528
01:50:24,310 --> 01:50:22,000
eventually figure out how to live off

2529
01:50:25,589 --> 01:50:24,320
the land to support human missions to

2530
01:50:27,109 --> 01:50:25,599
mars

2531
01:50:28,310 --> 01:50:27,119
thanks for taking the time to talk to us

2532
01:50:29,750 --> 01:50:28,320
today steve

2533
01:50:33,109 --> 01:50:29,760
thank you

2534
01:50:35,270 --> 01:50:33,119
and now that perseverance has safely

2535
01:50:37,669 --> 01:50:35,280
touched down on mars let's learn more

2536
01:50:40,550 --> 01:50:37,679
about what's in store for the rover

2537
01:50:43,430 --> 01:50:40,560
joining us now is surface mission

2538
01:50:45,990 --> 01:50:43,440

manager jessica samuels

2539
01:50:47,830 --> 01:50:46,000
jessica your surface operations team has

2540
01:50:51,109 --> 01:50:47,840
now taken over

2541
01:50:53,990 --> 01:50:51,119
what are they doing now yes hi raquel we

2542
01:50:56,790 --> 01:50:54,000
are so excited here in the surface

2543
01:50:58,870 --> 01:50:56,800
mission support area uh

2544
01:51:01,910 --> 01:50:58,880
the team will do a handover with the

2545
01:51:04,709 --> 01:51:01,920
entry descent and landing team and

2546
01:51:06,790 --> 01:51:04,719
pass any critical information and then

2547
01:51:08,790 --> 01:51:06,800
this team behind us will be the team

2548
01:51:11,510 --> 01:51:08,800
that does the health and safety

2549
01:51:12,470 --> 01:51:11,520
assessments daily as we progress on this

2550
01:51:15,189 --> 01:51:12,480
mission

2551
01:51:16,550 --> 01:51:15,199
and what do the upcoming weeks look like

2552
01:51:19,910 --> 01:51:16,560
for your team

2553
01:51:22,390 --> 01:51:19,920
so as we enter mars time now

2554
01:51:24,870 --> 01:51:22,400
the commanding team will be working

2555
01:51:27,910 --> 01:51:24,880
overnight while the rover is asleep so

2556
01:51:30,070 --> 01:51:27,920
that we can perform the initial

2557
01:51:32,149 --> 01:51:30,080
checkouts of our key rover functions and

2558
01:51:34,790 --> 01:51:32,159
our science instruments and we have to

2559
01:51:36,950 --> 01:51:34,800
do this all in time for the regularly

2560
01:51:39,270 --> 01:51:36,960
scheduled communication pass which

2561
01:51:41,270 --> 01:51:39,280
happens in the morning and so we will be

2562
01:51:44,390 --> 01:51:41,280
working around the clock

2563
01:51:45,350 --> 01:51:44,400

making sure that perseverance is healthy

2564
01:51:47,910 --> 01:51:45,360
and

2565
01:51:50,229 --> 01:51:47,920
we will begin this exciting adventure

2566
01:51:52,550 --> 01:51:50,239
and can you tell me what's it like

2567
01:51:54,229 --> 01:51:52,560
living on mars time

2568
01:51:56,470 --> 01:51:54,239
it's uh it's a little bit like

2569
01:51:59,510 --> 01:51:56,480
constantly uh you know flying and

2570
01:52:01,910 --> 01:51:59,520
changing your time zone uh the rover

2571
01:52:03,669 --> 01:52:01,920
um you know on earth the rover wakes up

2572
01:52:05,990 --> 01:52:03,679
at the same time every day but on earth

2573
01:52:07,990 --> 01:52:06,000
that's 40 minutes later so the team is

2574
01:52:10,149 --> 01:52:08,000
going to be shifting our work schedule

2575
01:52:11,750 --> 01:52:10,159
by 40 minutes as we come into work over

2576
01:52:15,430 --> 01:52:11,760
the next few weeks

2577
01:52:18,950 --> 01:52:15,440
so it'll be uh it'll be exciting and uh

2578
01:52:21,669 --> 01:52:18,960
and some uh some late late nights but uh

2579
01:52:24,629 --> 01:52:21,679
but we're also excited and uh we can't

2580
01:52:27,750 --> 01:52:24,639
wait it's a whole new lifestyle yes

2581
01:52:31,589 --> 01:52:27,760
we also have a student question for you

2582
01:52:33,589 --> 01:52:31,599
this is sophia's video

2583
01:52:36,229 --> 01:52:33,599
hi my name is sophia lopez and my

2584
01:52:38,790 --> 01:52:36,239
question for nasa is how's perseverance

2585
01:52:40,870 --> 01:52:38,800
going to survive and here's a drawing

2586
01:52:42,830 --> 01:52:40,880
that i made from perseverance thinking

2587
01:52:47,270 --> 01:52:42,840
about earth thank

2588
01:52:49,910 --> 01:52:47,280

you well sofia perseverance survives um

2589
01:52:52,310 --> 01:52:49,920
with a power source um that charges its

2590
01:52:55,430 --> 01:52:52,320
batteries uh overnight while it sleeps

2591
01:52:57,350 --> 01:52:55,440
and it keeps heaters uh on so that all

2592
01:53:00,310 --> 01:52:57,360
of our critical electronics can stay

2593
01:53:01,189 --> 01:53:00,320
warm as well as our mechanism but it's

2594
01:53:03,109 --> 01:53:01,199
really

2595
01:53:05,510 --> 01:53:03,119
survived by the team

2596
01:53:07,830 --> 01:53:05,520
that performs the health and safety

2597
01:53:09,270 --> 01:53:07,840
assessments every day and communicates

2598
01:53:10,870 --> 01:53:09,280
with the rover

2599
01:53:13,510 --> 01:53:10,880
and makes sure that

2600
01:53:15,589 --> 01:53:13,520
she's she's doing okay

2601
01:53:18,070 --> 01:53:15,599
well thanks for your time jessica and

2602
01:53:20,310 --> 01:53:18,080
good luck living on mars time thank you

2603
01:53:22,629 --> 01:53:20,320
should be fun

2604
01:53:29,589 --> 01:53:22,639
let's head back to marina as she gives

2605
01:53:34,950 --> 01:53:32,070
thanks so much raquel it's definitely

2606
01:53:37,669 --> 01:53:34,960
bustling behind me is not quiet like it

2607
01:53:39,669 --> 01:53:37,679
was just 20 minutes ago and congrats to

2608
01:53:41,910 --> 01:53:39,679
the whole team what an amazing

2609
01:53:44,470 --> 01:53:41,920
accomplishment mike watkins is the

2610
01:53:46,790 --> 01:53:44,480
director of nasa's jet propulsion

2611
01:53:49,430 --> 01:53:46,800
laboratory he was the mission manager

2612
01:53:52,149 --> 01:53:49,440
during the curiosity rover landing on

2613
01:53:54,629 --> 01:53:52,159

mars welcome mike

2614
01:53:57,510 --> 01:53:54,639
oh thanks glad to be here you can see

2615
01:53:59,109 --> 01:53:57,520
all my mask markings

2616
01:54:01,430 --> 01:53:59,119
well you were just celebrating and

2617
01:54:03,669 --> 01:54:01,440
rightly so now you've been around for a

2618
01:54:05,589 --> 01:54:03,679
number of mars landings what makes this

2619
01:54:07,510 --> 01:54:05,599
one special

2620
01:54:09,030 --> 01:54:07,520
well you know two things i mean it's the

2621
01:54:11,109 --> 01:54:09,040
biggest and best rover we've ever sent

2622
01:54:12,790 --> 01:54:11,119
to mars um and and it can really you

2623
01:54:14,390 --> 01:54:12,800
know do amazing things in terms of you

2624
01:54:16,149 --> 01:54:14,400
know its own scientific exploration of

2625
01:54:17,270 --> 01:54:16,159
this habitable environment you know at

2626
01:54:18,950 --> 01:54:17,280
jezreel

2627
01:54:20,149 --> 01:54:18,960
but you know it's also as as as you've

2628
01:54:22,229 --> 01:54:20,159
heard today you know it's the first step

2629
01:54:23,589 --> 01:54:22,239
in march sample return so really you

2630
01:54:25,589 --> 01:54:23,599
know it's it's not only doing its own

2631
01:54:27,030 --> 01:54:25,599
mission it's setting us up for a series

2632
01:54:28,790 --> 01:54:27,040
of missions and to bring those samples

2633
01:54:30,790 --> 01:54:28,800
back and you know a lot of the effort to

2634
01:54:32,310 --> 01:54:30,800
develop the rover was specifically

2635
01:54:33,589 --> 01:54:32,320
designed you know for that sampling and

2636
01:54:36,149 --> 01:54:33,599
caching system it's one of the most

2637
01:54:37,669 --> 01:54:36,159
complex robotic systems ever made and

2638
01:54:39,669 --> 01:54:37,679

you know having it down safely means

2639
01:54:43,270 --> 01:54:39,679
mars sample return continues right on

2640
01:54:45,990 --> 01:54:43,280
course and and and we are moving forward

2641
01:54:48,550 --> 01:54:46,000
wonderful now jpl has a long history

2642
01:54:50,550 --> 01:54:48,560
with robotic space exploration why do

2643
01:54:53,510 --> 01:54:50,560
you think it's so important to continue

2644
01:54:54,790 --> 01:54:53,520
to push those boundaries

2645
01:54:56,870 --> 01:54:54,800
you know there's a lot of reasons i mean

2646
01:54:58,870 --> 01:54:56,880
obviously you know for for places that

2647
01:55:01,510 --> 01:54:58,880
are far away like mars and even farther

2648
01:55:03,270 --> 01:55:01,520
away uh you know like europa uh right

2649
01:55:04,709 --> 01:55:03,280
now robots are the robotic expressions

2650
01:55:06,070 --> 01:55:04,719
the only way we can make those

2651
01:55:08,470 --> 01:55:06,080
scientific discoveries and really

2652
01:55:09,990 --> 01:55:08,480
understand these early uh habitable

2653
01:55:11,910 --> 01:55:10,000
environments in the case of europa maybe

2654
01:55:13,669 --> 01:55:11,920
it's even still habitable and you know

2655
01:55:15,750 --> 01:55:13,679
we're not ready to to go there with

2656
01:55:17,589 --> 01:55:15,760
astronauts yet uh but the robots are

2657
01:55:20,229 --> 01:55:17,599
ready to go there and so we always uh

2658
01:55:22,310 --> 01:55:20,239
you know our forerunners and pathfinders

2659
01:55:25,030 --> 01:55:22,320
of of of human exploration and we start

2660
01:55:27,589 --> 01:55:25,040
by sending you know our eyes and and

2661
01:55:29,270 --> 01:55:27,599
arms there in the form of a robot and it

2662
01:55:31,350 --> 01:55:29,280
is just fantastic to be able to do that

2663
01:55:32,709 --> 01:55:31,360

and to learn from each rover learn from

2664
01:55:34,390 --> 01:55:32,719
the science and the engineering and make

2665
01:55:36,070 --> 01:55:34,400
the next one better and make more and

2666
01:55:37,830 --> 01:55:36,080
more discoveries and every time we do

2667
01:55:39,910 --> 01:55:37,840
one of these missions we make fabulous

2668
01:55:43,270 --> 01:55:39,920
discoveries and uh and you know each one

2669
01:55:45,270 --> 01:55:43,280
is more exciting than the last

2670
01:55:47,430 --> 01:55:45,280
the future does look exciting now as

2671
01:55:50,229 --> 01:55:47,440
director of jpl what would you like to

2672
01:55:52,070 --> 01:55:50,239
say to those teams right now celebrating

2673
01:55:54,310 --> 01:55:52,080
oh you know obviously they they have

2674
01:55:56,229 --> 01:55:54,320
earned it let me tell you i mean they uh

2675
01:55:57,589 --> 01:55:56,239
have worked you know for years and years

2676
01:55:59,430 --> 01:55:57,599
on this mission and then in the past

2677
01:56:01,030 --> 01:55:59,440
year of course we had the covet

2678
01:56:02,790 --> 01:56:01,040
experience and and you know i want to

2679
01:56:04,709 --> 01:56:02,800
thank not only the team but also you

2680
01:56:07,510 --> 01:56:04,719
know all of jpl you know a lot of folks

2681
01:56:09,430 --> 01:56:07,520
had to had uh had to pitch in here you

2682
01:56:11,510 --> 01:56:09,440
know in terms of making sure our remote

2683
01:56:13,350 --> 01:56:11,520
telework you know our it systems were

2684
01:56:14,950 --> 01:56:13,360
good enough to to support folks working

2685
01:56:16,950 --> 01:56:14,960
from home you know all of the folks

2686
01:56:19,189 --> 01:56:16,960
looking at at ppe and our safe

2687
01:56:21,510 --> 01:56:19,199
distancing and reconfiguring facilities

2688
01:56:23,510 --> 01:56:21,520

uh to make them safe for the employees

2689
01:56:25,109 --> 01:56:23,520
um it's just an incredible amount of

2690
01:56:27,510 --> 01:56:25,119
work by the entire lab and of course

2691
01:56:29,430 --> 01:56:27,520
especially by this team and uh you know

2692
01:56:31,990 --> 01:56:29,440
and in one sense you know the seven

2693
01:56:33,430 --> 01:56:32,000
minutes of terror are very exciting uh

2694
01:56:35,430 --> 01:56:33,440
but on the other hand you know the

2695
01:56:36,790 --> 01:56:35,440
missions just started right we built the

2696
01:56:38,790 --> 01:56:36,800
mission you know not to land but

2697
01:56:41,030 --> 01:56:38,800
actually to drive and get the samples

2698
01:56:43,830 --> 01:56:41,040
and do other uh technology um you know

2699
01:56:45,910 --> 01:56:43,840
demonstrations and so you know for

2700
01:56:47,910 --> 01:56:45,920
much of the team you know uh this part

2701
01:56:49,669 --> 01:56:47,920
of the mission is over but but for most

2702
01:56:51,350 --> 01:56:49,679
of the team the mission's really just

2703
01:56:53,030 --> 01:56:51,360
starting and so uh you know i think

2704
01:56:55,430 --> 01:56:53,040
they're very excited but uh you know

2705
01:56:57,109 --> 01:56:55,440
everybody i think can take a big uh a

2706
01:56:59,669 --> 01:56:57,119
deep breath and a sigh of relief now

2707
01:57:01,990 --> 01:56:59,679
that we are safely down on the surface

2708
01:57:04,149 --> 01:57:02,000
yes that collective sigh of relief and i

2709
01:57:06,310 --> 01:57:04,159
hear a lot of excitement and celebration

2710
01:57:08,149 --> 01:57:06,320
behind me as well so thanks so much for

2711
01:57:09,910 --> 01:57:08,159
joining me mike it's my pleasure and

2712
01:57:12,070 --> 01:57:09,920
thanks to everyone for joining us too

2713
01:57:14,149 --> 01:57:12,080

congrats again to the mars 2020

2714
01:57:16,870 --> 01:57:14,159
perseverance team for a successful

2715
01:57:20,149 --> 01:57:16,880
landing back to you raquel

2716
01:57:23,990 --> 01:57:20,159
now there will be a flight test coming

2717
01:57:25,750 --> 01:57:24,000
up for the ingenuity mars helicopter and

2718
01:57:28,310 --> 01:57:25,760
if this technology experiment is

2719
01:57:31,270 --> 01:57:28,320
successful it would mark the first time

2720
01:57:34,390 --> 01:57:31,280
we have taken a power controlled flight

2721
01:57:38,709 --> 01:57:36,629
sometimes you have to do something just

2722
01:57:40,629 --> 01:57:38,719
to show that you can do it

2723
01:57:42,550 --> 01:57:40,639
when the wright brothers flew for the

2724
01:57:43,750 --> 01:57:42,560
first time they do an experimental

2725
01:57:45,990 --> 01:57:43,760
aircraft

2726
01:57:47,910 --> 01:57:46,000
and in the same way the mars helicopter

2727
01:57:49,830 --> 01:57:47,920
is designed to show that we can fly

2728
01:57:57,830 --> 01:57:49,840
power and helicopter flight in the

2729
01:58:02,950 --> 01:58:00,390
from day one this was the unwavering

2730
01:58:04,870 --> 01:58:02,960
dream of our team to get our helicopter

2731
01:58:06,950 --> 01:58:04,880
launched to mars

2732
01:58:09,669 --> 01:58:06,960
so that we can get the opportunity to do

2733
01:58:12,229 --> 01:58:09,679
the very first rotograph flight test

2734
01:58:14,790 --> 01:58:12,239
in the actual environment of mars

2735
01:58:16,870 --> 01:58:14,800
it's extremely difficult to fly

2736
01:58:18,149 --> 01:58:16,880
at mars because atmosphere is so thin

2737
01:58:20,629 --> 01:58:18,159
compared to earth

2738
01:58:22,870 --> 01:58:20,639

at mars is less than one percent so the

2739
01:58:24,870 --> 01:58:22,880
first and foremost challenge is to make

2740
01:58:26,950 --> 01:58:24,880
a vehicle that's light enough to be

2741
01:58:28,950 --> 01:58:26,960
lifted and then the second is to

2742
01:58:33,109 --> 01:58:28,960
generate lift the rotor system has to

2743
01:58:37,589 --> 01:58:35,669
hundred fast six hundred we're spending

2744
01:58:39,270 --> 01:58:37,599
between two thousand and three thousand

2745
01:58:42,149 --> 01:58:39,280
revolutions per minute and it takes a

2746
01:58:43,750 --> 01:58:42,159
lot of energy so it's that balance of a

2747
01:58:44,629 --> 01:58:43,760
very light system

2748
01:58:47,270 --> 01:58:44,639
yet

2749
01:58:49,669 --> 01:58:47,280
having enough energy that's needed to

2750
01:58:52,390 --> 01:58:49,679
you know spin the rotor so fast to lift

2751
01:58:54,149 --> 01:58:52,400
and on top of it having to design in the

2752
01:58:55,830 --> 01:58:54,159
autonomy

2753
01:58:57,910 --> 01:58:55,840
it has to be fully autonomous from the

2754
01:58:59,589 --> 01:58:57,920
time it takes off the time it lands what

2755
01:59:02,149 --> 01:58:59,599
we do do on the ground is we plan the

2756
01:59:05,990 --> 01:59:02,159
flights and so we determine from here

2757
01:59:09,990 --> 01:59:06,000
where we want the helicopter to go

2758
01:59:11,990 --> 01:59:10,000
our experiment window is 30 martian days

2759
01:59:13,510 --> 01:59:12,000
so we have planned

2760
01:59:16,790 --> 01:59:13,520
up to five flights

2761
01:59:18,709 --> 01:59:16,800
of incremental difficulty very first

2762
01:59:21,270 --> 01:59:18,719
flight the main thing is we want to get

2763
01:59:22,709 --> 01:59:21,280

the legs off the ground and so we will

2764
01:59:24,310 --> 01:59:22,719
basically go up

2765
01:59:25,830 --> 01:59:24,320
about three meters

2766
01:59:27,750 --> 01:59:25,840
and we'll hover there

2767
01:59:30,070 --> 01:59:27,760
and then we'll come down again and that

2768
01:59:31,270 --> 01:59:30,080
will be the first you know really major

2769
01:59:32,709 --> 01:59:31,280
milestone

2770
01:59:34,709 --> 01:59:32,719
most of our flights will be at the three

2771
01:59:36,629 --> 01:59:34,719
to five meter height we will be going

2772
01:59:39,109 --> 01:59:36,639
horizontally again at a few meters per

2773
01:59:41,109 --> 01:59:39,119
second probably go out you know 50 70

2774
01:59:42,870 --> 01:59:41,119
liters and come back in successive

2775
01:59:44,950 --> 01:59:42,880
flights we'll probably push that further

2776
01:59:47,270 --> 01:59:44,960
try to go further so our priority will

2777
01:59:49,270 --> 01:59:47,280
be to get back engineering telemetry and

2778
01:59:50,790 --> 01:59:49,280
not so much images but i'm sure they'll

2779
01:59:53,270 --> 01:59:50,800
return a few you know because they'll

2780
01:59:55,990 --> 01:59:53,280
always look cool

2781
01:59:58,470 --> 01:59:56,000
at this point we've tested all we can on

2782
02:00:00,310 --> 01:59:58,480
earth we have mathematical models that

2783
02:00:02,950 --> 02:00:00,320
shows how it will fly at mars and we've

2784
02:00:04,870 --> 02:00:02,960
tested it in the simulated environment

2785
02:00:07,109 --> 02:00:04,880
that we can create on earth

2786
02:00:09,430 --> 02:00:07,119
it really is time now to

2787
02:00:11,589 --> 02:00:09,440
do the real flood types at mars

2788
02:00:13,589 --> 02:00:11,599

nothing is a given but we have done

2789
02:00:15,350 --> 02:00:13,599
everything we can in terms of a test

2790
02:00:17,189 --> 02:00:15,360
program here on earth the vehicle is

2791
02:00:19,109 --> 02:00:17,199
performing extremely well so far it's

2792
02:00:20,550 --> 02:00:19,119
been doing exactly the right thing even

2793
02:00:22,629 --> 02:00:20,560
right now and it's bolted onto the

2794
02:00:24,629 --> 02:00:22,639
perseverance rover so there's a very

2795
02:00:26,629 --> 02:00:24,639
good chance that we'll pull it off yes

2796
02:00:27,750 --> 02:00:26,639
but it's still high risk

2797
02:00:29,510 --> 02:00:27,760
and

2798
02:00:31,510 --> 02:00:29,520
none of us forget that you could have a

2799
02:00:33,189 --> 02:00:31,520
glitch that you know

2800
02:00:36,390 --> 02:00:33,199
could be an end of mission yes it's

2801
02:00:40,470 --> 02:00:36,400
going to be exciting reacting to any

2802
02:00:42,229 --> 02:00:40,480
surprises we have we can't wait

2803
02:00:44,550 --> 02:00:42,239
what's really most important is

2804
02:00:47,030 --> 02:00:44,560
everything we're learning here is for

2805
02:00:53,430 --> 02:00:47,040
the future rotograph systems that we

2806
02:00:58,470 --> 02:00:55,589
mimi ong is the project manager for

2807
02:01:01,109 --> 02:00:58,480
ingenuity she joins us now as they await

2808
02:01:04,229 --> 02:01:01,119
a chance to check out their helicopter

2809
02:01:05,750 --> 02:01:04,239
in the coming days welcome mimi

2810
02:01:07,189 --> 02:01:05,760
thank you marina

2811
02:01:09,510 --> 02:01:07,199
oh my goodness we've been talking about

2812
02:01:10,790 --> 02:01:09,520
this for months mimi did you ever think

2813
02:01:13,270 --> 02:01:10,800

you'd be here at this point i mean

2814
02:01:16,070 --> 02:01:13,280
what's going on in your head right now

2815
02:01:18,550 --> 02:01:16,080
this is super exciting now we have been

2816
02:01:19,669 --> 02:01:18,560
working on mars helicopter for over six

2817
02:01:21,830 --> 02:01:19,679
years

2818
02:01:23,589 --> 02:01:21,840
testing and carefully designing it for

2819
02:01:25,030 --> 02:01:23,599
operation at mars so what's going

2820
02:01:28,390 --> 02:01:25,040
through my mind

2821
02:01:32,790 --> 02:01:28,400
ingenuity mars helicopter is finally at

2822
02:01:35,270 --> 02:01:32,800
the destination that it is designed for

2823
02:01:37,189 --> 02:01:35,280
now that ingenuity is on mars what is

2824
02:01:39,350 --> 02:01:37,199
the timeline you hope to accomplish as

2825
02:01:41,430 --> 02:01:39,360
you move forward

2826
02:01:43,669 --> 02:01:41,440
we have a series of major milestones

2827
02:01:46,149 --> 02:01:43,679
between now and ingenuity's first flight

2828
02:01:47,910 --> 02:01:46,159
so tomorrow we'll turn on the helicopter

2829
02:01:50,149 --> 02:01:47,920
and the space station could confirm

2830
02:01:52,149 --> 02:01:50,159
health after experiencing the dynamics

2831
02:01:54,229 --> 02:01:52,159
through the edl just now

2832
02:01:56,550 --> 02:01:54,239
and the next major milestone will be

2833
02:01:58,790 --> 02:01:56,560
when the rover deploys the helicopter to

2834
02:02:01,589 --> 02:01:58,800
the surface and that marks the first

2835
02:02:03,350 --> 02:02:01,599
moment that ingenuity operates on its

2836
02:02:05,510 --> 02:02:03,360
own in a stand-alone manner and

2837
02:02:08,390 --> 02:02:05,520
surviving that first cold frigid night

2838
02:02:11,030 --> 02:02:08,400

of mars will be a major milestone we'll

2839
02:02:13,350 --> 02:02:11,040
execute a series of checkouts and then

2840
02:02:15,589 --> 02:02:13,360
we will perform that very important

2841
02:02:17,750 --> 02:02:15,599
first flight and if the first flight is

2842
02:02:20,149 --> 02:02:17,760
successful we have up to four more

2843
02:02:21,350 --> 02:02:20,159
flights in the 30 martian days that we

2844
02:02:23,030 --> 02:02:21,360
have set aside for our flight

2845
02:02:24,629 --> 02:02:23,040
experiments

2846
02:02:25,220 --> 02:02:24,639
and that's when you finally can breathe

2847
02:02:27,270 --> 02:02:25,230
right mimi

2848
02:02:29,510 --> 02:02:27,280
[Laughter]

2849
02:02:33,189 --> 02:02:29,520
now why is it so important to have that

2850
02:02:36,790 --> 02:02:33,199
aerial dimension to space exploration

2851
02:02:39,430 --> 02:02:36,800
a helicopter flying far ahead of rovers

2852
02:02:41,189 --> 02:02:39,440
and astronauts in the future can provide

2853
02:02:43,350 --> 02:02:41,199
high definition

2854
02:02:44,950 --> 02:02:43,360
reconnaissance information for the

2855
02:02:46,550 --> 02:02:44,960
rovers and the astronauts before they

2856
02:02:49,910 --> 02:02:46,560
take the long journeys

2857
02:02:52,310 --> 02:02:49,920
and as importantly being able to fly

2858
02:02:54,790 --> 02:02:52,320
will enable us to get to places that we

2859
02:02:57,109 --> 02:02:54,800
cannot get to with rovers and astronauts

2860
02:02:59,750 --> 02:02:57,119
like sites of steep cliffs deep inside

2861
02:03:03,109 --> 02:02:59,760
crevices areas of high scientific

2862
02:03:04,870 --> 02:03:03,119
interest it will be game changing

2863
02:03:06,709 --> 02:03:04,880

game changing is right and we've talked

2864
02:03:09,510 --> 02:03:06,719
about this a lot you've mentioned the

2865
02:03:13,589 --> 02:03:09,520
risk is huge mimi but the reward is high

2866
02:03:15,589 --> 02:03:13,599
what will be your greatest reward

2867
02:03:18,870 --> 02:03:15,599
you know our team started with the

2868
02:03:20,629 --> 02:03:18,880
question of whether a helicopter can fly

2869
02:03:22,870 --> 02:03:20,639
at mars given the extremely thin

2870
02:03:25,510 --> 02:03:22,880
environment and we systematically

2871
02:03:27,830 --> 02:03:25,520
demonstrated a series of technical steps

2872
02:03:30,870 --> 02:03:27,840
we demonstrated lift first and then we

2873
02:03:32,390 --> 02:03:30,880
demonstrated lift and the first ever

2874
02:03:34,390 --> 02:03:32,400
power control

2875
02:03:36,709 --> 02:03:34,400
rotorcraft flight and simulated mars

2876
02:03:39,510 --> 02:03:36,719
atmospheric density and then we went on

2877
02:03:42,390 --> 02:03:39,520
to build the full up helicopter that can

2878
02:03:46,229 --> 02:03:42,400
not only fly but operate and survive

2879
02:03:48,629 --> 02:03:46,239
autonomously at mars all under 1.8

2880
02:03:50,629 --> 02:03:48,639
kilograms about four pounds

2881
02:03:51,910 --> 02:03:50,639
and each of these major milestones have

2882
02:03:54,629 --> 02:03:51,920
been a first

2883
02:03:57,589 --> 02:03:54,639
and the success of each of these has

2884
02:03:59,350 --> 02:03:57,599
been so rewarding and along the way the

2885
02:04:01,109 --> 02:03:59,360
rewards just kept coming and i have to

2886
02:04:02,629 --> 02:04:01,119
tell you at this moment is going up

2887
02:04:03,430 --> 02:04:02,639
exponentially

2888
02:04:06,550 --> 02:04:03,440

so

2889
02:04:10,229 --> 02:04:06,560
after all these tests analysis

2890
02:04:12,229 --> 02:04:10,239
simulations and more tests on earth our

2891
02:04:15,910 --> 02:04:12,239
team now gets the chance

2892
02:04:18,149 --> 02:04:15,920
to test prove and learn how it works in

2893
02:04:21,030 --> 02:04:18,159
the actual environment of mars our team

2894
02:04:23,669 --> 02:04:21,040
can ask for a bigger reward than that

2895
02:04:24,950 --> 02:04:23,679
oh mimi i'm so happy for you and your

2896
02:04:27,750 --> 02:04:24,960
team and now we're going to take a

2897
02:04:28,870 --> 02:04:27,760
question from social media on instagram

2898
02:04:32,390 --> 02:04:28,880
for you

2899
02:04:35,830 --> 02:04:32,400
at not vibhuti asks is the helicopter

2900
02:04:39,109 --> 02:04:35,840
going to be doing science

2901
02:04:42,390 --> 02:04:39,119
well the helicopter ingenuity is a

2902
02:04:44,870 --> 02:04:42,400
technology demonstration and we are

2903
02:04:47,589 --> 02:04:44,880
we are demonstrating the ability to fly

2904
02:04:49,910 --> 02:04:47,599
and learning how to fly for the very

2905
02:04:51,830 --> 02:04:49,920
very first time and so this is a

2906
02:04:54,470 --> 02:04:51,840
technology demonstration and a

2907
02:04:56,310 --> 02:04:54,480
pathfinder for future larger rotorcraft

2908
02:04:58,870 --> 02:04:56,320
future missions that will carry much

2909
02:05:00,790 --> 02:04:58,880
larger instruments so on this mission

2910
02:05:04,629 --> 02:05:00,800
we're not doing any science we're

2911
02:05:07,109 --> 02:05:04,639
concentrating on engineering uh data how

2912
02:05:10,149 --> 02:05:07,119
did the vehicle perform and as you saw

2913
02:05:12,390 --> 02:05:10,159

uh bob bellram uh in the video before we

2914
02:05:14,709 --> 02:05:12,400
will be taking a few color picture first

2915
02:05:17,189 --> 02:05:14,719
ever color pictures uh from uh the

2916
02:05:19,270 --> 02:05:17,199
flying aerial vantage point but they'll

2917
02:05:21,910 --> 02:05:19,280
be icing on the cake for this one this

2918
02:05:24,149 --> 02:05:21,920
is all about engineering data and how do

2919
02:05:25,990 --> 02:05:24,159
we fly compared to all our tests we have

2920
02:05:27,990 --> 02:05:26,000
done on earth

2921
02:05:30,470 --> 02:05:28,000
mean so much for your team and the

2922
02:05:33,189 --> 02:05:30,480
future generations of scientists and

2923
02:05:35,510 --> 02:05:33,199
engineers to look forward to

2924
02:05:37,189 --> 02:05:35,520
thank you thank you so much for joining

2925
02:05:39,430 --> 02:05:37,199
us mimi and good luck to your team with

2926
02:05:41,910 --> 02:05:39,440
that first test flight

2927
02:05:44,149 --> 02:05:41,920
thank you so much now we look forward to

2928
02:05:46,470 --> 02:05:44,159
the perseverance rover and ingenuity

2929
02:05:49,189 --> 02:05:46,480
helicopter beginning their journeys on

2930
02:05:51,830 --> 02:05:49,199
mars as their adventures are just about

2931
02:05:54,950 --> 02:05:51,840
to start go perseverance and go

2932
02:05:56,390 --> 02:05:54,960
ingenuity back to you raquel

2933
02:05:59,350 --> 02:05:56,400
thanks marina

2934
02:06:02,390 --> 02:05:59,360
landing on mars is never easy

2935
02:06:05,589 --> 02:06:02,400
but this team has persevered and nasa's

2936
02:06:07,030 --> 02:06:05,599
fifth rover is on the red planet you can

2937
02:06:08,069 --> 02:06:07,040
still hear them buzzing in the back

2938
02:06:09,990 --> 02:06:08,079

right now

2939
02:06:13,109 --> 02:06:10,000
and to get the latest updates on

2940
02:06:16,149 --> 02:06:13,119
perseverance as it explores mars follow

2941
02:06:17,189 --> 02:06:16,159
at nasa persevere on facebook and

2942
02:06:19,109 --> 02:06:17,199
twitter

2943
02:06:21,510 --> 02:06:19,119
i'd like to thank everyone watching for

2944
02:06:24,149 --> 02:06:21,520
joining us today and to the students and

2945
02:06:26,470 --> 02:06:24,159
teachers tuning in we hope you learned a

2946
02:06:29,270 --> 02:06:26,480
lot from today's landing and thank you

2947
02:06:32,149 --> 02:06:29,280
for all your questions we have a news

2948
02:06:34,470 --> 02:06:32,159
briefing coming up at 2 30 p.m pacific

2949
02:06:36,709 --> 02:06:34,480
time that briefing will wrap up the day

2950
02:06:37,990 --> 02:06:36,719
and include reactions from perseverance

2951
02:06:40,069 --> 02:06:38,000
team members

2952
02:06:42,310 --> 02:06:40,079
we'll leave you now with some of the

2953
02:06:43,270 --> 02:06:42,320
landing celebration photos you've shared

2954
02:06:45,669 --> 02:06:43,280
with us

2955
02:06:48,470 --> 02:06:45,679
set to youngblood's cover of david

2956
02:06:56,260 --> 02:06:48,480
bowie's life on mars i'm raquel

2957
02:06:56,270 --> 02:07:09,750
[Music]

2958
02:07:22,069 --> 02:07:12,020
but a friend is nowhere

2959
02:07:39,030 --> 02:07:27,000
and she's hooked on the silver screen

2960
02:08:07,990 --> 02:07:39,040
[Music]

2961
02:08:08,000 --> 02:08:14,570
he's in the best

2962
02:08:14,580 --> 02:08:27,270
[Music]

2963
02:08:27,280 --> 02:08:30,490

so

2964
02:08:30,500 --> 02:08:47,430
[Music]

2965
02:09:06,240 --> 02:08:50,690
another word

2966
02:09:47,830 --> 02:09:16,950
[Music]

2967
02:09:47,840 --> 02:09:52,670
oh