1
00:02:06,830 --> 00:00:50,500
[Music]

2
00:02:06,840 --> 00:02:13,280
so

3
00:03:44,830 --> 00:02:29,580
[Music]

4
00:04:47,840 --> 00:03:46,030
so

5
00:05:47,830 --> 00:04:54,760
[Music]

6
00:05:52,629 --> 00:05:49,749
welcome to nasa's jet propulsion

7
00:05:55,350 --> 00:05:52,639
laboratory in southern california

8
00:05:56,950 --> 00:05:55,360
nasa's ingenuity mars helicopter hitched

9
00:06:00,150 --> 00:05:56,960
a ride to the red planet

10
00:06:02,309 --> 00:06:00,160
on the mars 2020 perseverance rover

11
00:06:04,150 --> 00:06:02,319
which landed in jezreel crater on

12
00:06:06,390 --> 00:06:04,160
february 18th

13
00:06:07,990 --> 00:06:06,400

now ingenuity is getting ready to

14
00:06:10,230 --> 00:06:08,000
attempt the first

15
00:06:11,189 --> 00:06:10,240
powered controlled flight on another

16
00:06:13,110 --> 00:06:11,199
planet

17
00:06:14,950 --> 00:06:13,120
today we will update you on the

18
00:06:17,909 --> 00:06:14,960
helicopters operations

19
00:06:19,110 --> 00:06:17,919
and what to expect from its first flight

20
00:06:22,309 --> 00:06:19,120
currently scheduled for

21
00:06:25,110 --> 00:06:22,319
sunday april 11th i'm your host

22
00:06:26,950 --> 00:06:25,120
raquel villanueva to tell us about

23
00:06:30,629 --> 00:06:26,960
ingenuity's upcoming flight

24
00:06:32,870 --> 00:06:30,639
is thomas cerbukin nasa associate

25
00:06:37,029 --> 00:06:32,880
administrator for science

26
00:06:41,110 --> 00:06:37,039
mimi ingenuity project manager

27
00:06:44,469 --> 00:06:41,120
tim cannon ingenuity operations lead

28
00:06:47,510 --> 00:06:44,479
amy quan ingenuity chamber test

29
00:06:50,710 --> 00:06:47,520
engineer elsa jensen

30
00:06:51,749 --> 00:06:50,720
mastcam z uplink operations lead for

31
00:06:54,790 --> 00:06:51,759
mail and space

32
00:06:56,629 --> 00:06:54,800
side systems for anyone watching who

33
00:06:59,029 --> 00:06:56,639
would like to submit a question

34
00:07:00,950 --> 00:06:59,039
you can do so by using the mars

35
00:07:02,870 --> 00:07:00,960
helicopter hashtag

36
00:07:05,990 --> 00:07:02,880
our phone lines are now open to the

37
00:07:09,510 --> 00:07:06,000
media you can ask a question by pressing

38
00:07:11,909 --> 00:07:09,520

star one and enter the queue to start

39
00:07:13,990 --> 00:07:11,919
i'd like to welcome thomas zubukin who

40
00:07:15,510 --> 00:07:14,000
will tell us about the importance of

41
00:07:17,990 --> 00:07:15,520
technology demonstrations

42
00:07:19,510 --> 00:07:18,000
like ingenuity thanks for getting us

43
00:07:22,550 --> 00:07:19,520
started thomas

44
00:07:24,309 --> 00:07:22,560
thanks so much raquel i want to take you

45
00:07:27,350 --> 00:07:24,319
back

46
00:07:28,469 --> 00:07:27,360
at 10 30 in the morning on a cool

47
00:07:31,670 --> 00:07:28,479
december morning

48
00:07:35,029 --> 00:07:31,680
in kitty hawk north carolina

49
00:07:37,990 --> 00:07:35,039
history was made it took

50
00:07:39,909 --> 00:07:38,000
12 seconds to make history the first

51
00:07:43,029 --> 00:07:39,919
controlled flight here

52
00:07:44,629 --> 00:07:43,039
on earth and something that had huge

53
00:07:47,029 --> 00:07:44,639
consequences

54
00:07:49,589 --> 00:07:47,039
and i was thinking about that yesterday

55
00:07:50,950 --> 00:07:49,599
as i sat on an airplane from dc to los

56
00:07:53,990 --> 00:07:50,960
angeles

57
00:07:56,550 --> 00:07:54,000
benefiting from that technology

58
00:08:00,390 --> 00:07:56,560
demonstration

59
00:08:03,189 --> 00:08:00,400
we're ready on the surface of

60
00:08:06,150 --> 00:08:03,199
mars and i want to bring up that selfie

61
00:08:09,430 --> 00:08:06,160
image that we've seen on social media

62
00:08:12,469 --> 00:08:09,440
an image that shows that we're ready

63
00:08:14,629 --> 00:08:12,479

for another historic moment

64
00:08:16,230 --> 00:08:14,639
a historic moment the likes of which i

65
00:08:19,670 --> 00:08:16,240
believe

66
00:08:22,710 --> 00:08:19,680
have analogs in 1903

67
00:08:26,070 --> 00:08:22,720
controlled flight on a different

68
00:08:27,830 --> 00:08:26,080
planet so when i look at this picture of

69
00:08:30,309 --> 00:08:27,840
course i think

70
00:08:32,149 --> 00:08:30,319
of the amazing team that got us there

71
00:08:33,829 --> 00:08:32,159
you know the amazing people here at jbl

72
00:08:37,029 --> 00:08:33,839
you're going to hear from them

73
00:08:39,269 --> 00:08:37,039
but also the industrial partners

74
00:08:41,509 --> 00:08:39,279
that supported us including lockheed

75
00:08:44,630 --> 00:08:41,519
martin for example to help with the

76
00:08:46,070 --> 00:08:44,640
release device i think of the

77
00:08:47,990 --> 00:08:46,080
colleagues in the aeronautics

78
00:08:50,070 --> 00:08:48,000
directorate at

79
00:08:51,430 --> 00:08:50,080
nasa and then the space tech and the

80
00:08:53,110 --> 00:08:51,440
human exploration

81
00:08:56,070 --> 00:08:53,120
director colleagues that brought

82
00:08:58,630 --> 00:08:56,080
instruments onto the perseverance

83
00:08:59,670 --> 00:08:58,640
rover i think of the team that came

84
00:09:02,230 --> 00:08:59,680
together

85
00:09:03,190 --> 00:09:02,240
with two words that will always be

86
00:09:05,829 --> 00:09:03,200
attached

87
00:09:06,829 --> 00:09:05,839
to both of these vehicles the first one

88
00:09:09,590 --> 00:09:06,839

of course

89
00:09:10,630 --> 00:09:09,600
perseverance and the second one

90
00:09:14,230 --> 00:09:10,640
ingenuity

91
00:09:15,190 --> 00:09:14,240
those two words i think are especially

92
00:09:17,829 --> 00:09:15,200
as we do this

93
00:09:20,230 --> 00:09:17,839
still under clovid times words that will

94
00:09:23,350 --> 00:09:20,240
always be attached to the history

95
00:09:25,590 --> 00:09:23,360
of this amazing you know feat

96
00:09:27,829 --> 00:09:25,600
that we're about to attempt i want to

97
00:09:29,990 --> 00:09:27,839
talk about technology demonstration

98
00:09:31,910 --> 00:09:30,000
and and if you have paid attention you

99
00:09:34,829 --> 00:09:31,920
may have noticed that we've really

100
00:09:37,269 --> 00:09:34,839
added quite a number of technology

101
00:09:40,389 --> 00:09:37,279
demonstrations specifically

102
00:09:42,230 --> 00:09:40,399
to our portfolio of missions not just in

103
00:09:45,269 --> 00:09:42,240
the science mission directorate

104
00:09:48,630 --> 00:09:45,279
but across the entire agency

105
00:09:50,790 --> 00:09:48,640
consider for example the psyche

106
00:09:52,550 --> 00:09:50,800
spacecraft and i just want to tell you

107
00:09:55,829 --> 00:09:52,560
i'm so excited to actually go

108
00:09:57,590 --> 00:09:55,839
visit that spacecraft this afternoon

109
00:09:59,509 --> 00:09:57,600
next door to here together with the

110
00:10:00,550 --> 00:09:59,519
principal investigator who has never

111
00:10:02,550 --> 00:10:00,560
seen it

112
00:10:03,670 --> 00:10:02,560
and uh and of course the reason i'm

113
00:10:06,150 --> 00:10:03,680

talking about psyche

114
00:10:07,509 --> 00:10:06,160
is that this amazing mission to this

115
00:10:09,990 --> 00:10:07,519
asteroid psyche

116
00:10:11,590 --> 00:10:10,000
this potential metal world out there i

117
00:10:14,310 --> 00:10:11,600
want to talk about the deep space

118
00:10:16,310 --> 00:10:14,320
optical communication system that's

119
00:10:19,509 --> 00:10:16,320
space tech is funding that's on top of

120
00:10:22,230 --> 00:10:19,519
it allowing us to test the ability

121
00:10:23,430 --> 00:10:22,240
of getting high bandwidth communication

122
00:10:26,630 --> 00:10:23,440
all the way from

123
00:10:29,350 --> 00:10:26,640
mars distances to the earth

124
00:10:30,310 --> 00:10:29,360
i want to talk about next the

125
00:10:32,310 --> 00:10:30,320
chronograph

126
00:10:33,509 --> 00:10:32,320
on board the nancy grace robin space

127
00:10:36,310 --> 00:10:33,519
telescope

128
00:10:37,110 --> 00:10:36,320
which is a technology demonstration also

129
00:10:39,829 --> 00:10:37,120
developed

130
00:10:40,389 --> 00:10:39,839
here to prove a technology to allow us

131
00:10:44,470 --> 00:10:40,399
to

132
00:10:47,910 --> 00:10:44,480
kind of image or kind of detect

133
00:10:50,470 --> 00:10:47,920
you know worlds exoplanets at

134
00:10:52,550 --> 00:10:50,480
brightnesses that are 20 million times

135
00:10:54,949 --> 00:10:52,560
weaker than the star in the middle

136
00:10:57,190 --> 00:10:54,959
allowing us potentially to open up new

137
00:11:00,150 --> 00:10:57,200
ways of investigating these worlds

138
00:11:01,509 --> 00:11:00,160

as we're searching for other planets

139
00:11:04,230 --> 00:11:01,519
like our earth

140
00:11:05,670 --> 00:11:04,240
or planets that the likes of which we

141
00:11:10,150 --> 00:11:05,680
have no analogues of

142
00:11:11,990 --> 00:11:10,160
right here in the solar system other

143
00:11:13,670 --> 00:11:12,000
directorates have also done technology

144
00:11:15,670 --> 00:11:13,680
demonstrations and i'll talk about two

145
00:11:16,630 --> 00:11:15,680
of them that will go with the uncrewed

146
00:11:18,870 --> 00:11:16,640
artemis

147
00:11:20,069 --> 00:11:18,880
mission the first one is the lunar

148
00:11:22,870 --> 00:11:20,079
flashlight

149
00:11:24,949 --> 00:11:22,880
a cubesat that will look for water

150
00:11:28,230 --> 00:11:24,959
especially frozen water

151
00:11:30,870 --> 00:11:28,240
at at the moon and help guide human

152
00:11:34,710 --> 00:11:30,880
exploration and robotic exploration

153
00:11:37,350 --> 00:11:34,720
on our on this uh world next to us

154
00:11:39,350 --> 00:11:37,360
the near-earth asteroid scout which is

155
00:11:42,389 --> 00:11:39,360
another cubesat will go

156
00:11:45,430 --> 00:11:42,399
well with this entire artemis mission

157
00:11:46,310 --> 00:11:45,440
will look for asteroids that we could

158
00:11:48,790 --> 00:11:46,320
explore

159
00:11:49,750 --> 00:11:48,800
robotically and perhaps with humans in

160
00:11:51,829 --> 00:11:49,760
the future

161
00:11:54,550 --> 00:11:51,839
with novel propulsion technologies that

162
00:11:56,949 --> 00:11:54,560
it's going to demonstrate

163
00:11:59,030 --> 00:11:56,959

and the final technology demonstration i

164
00:12:01,030 --> 00:11:59,040
want to talk to you about today

165
00:12:03,269 --> 00:12:01,040
uh looks like this little plane but it's

166
00:12:06,949 --> 00:12:03,279
the maxwell aircraft

167
00:12:08,790 --> 00:12:06,959
uh demonstrating electric flight in

168
00:12:10,310 --> 00:12:08,800
novel ways of integrating that

169
00:12:12,629 --> 00:12:10,320
propulsion technology

170
00:12:14,069 --> 00:12:12,639
and approving it and really moving us

171
00:12:16,990 --> 00:12:14,079
towards

172
00:12:18,870 --> 00:12:17,000
net zero emission flight a

173
00:12:22,629 --> 00:12:18,880
transformative change

174
00:12:25,509 --> 00:12:22,639
to all of technologies that of course

175
00:12:27,670 --> 00:12:25,519
we are enabling us to travel across the

176
00:12:30,710 --> 00:12:27,680
country and around the world

177
00:12:31,750 --> 00:12:30,720
so these are some uh technology

178
00:12:34,550 --> 00:12:31,760
demonstrations of

179
00:12:36,790 --> 00:12:34,560
many that are there that give us this

180
00:12:40,310 --> 00:12:36,800
high risk right reward

181
00:12:43,190 --> 00:12:40,320
time opportunity to really change

182
00:12:44,069 --> 00:12:43,200
the trajectory of what's possible just

183
00:12:47,430 --> 00:12:44,079
like

184
00:12:47,990 --> 00:12:47,440
we we want to see ingenuity do in the

185
00:12:52,150 --> 00:12:48,000
next

186
00:12:55,190 --> 00:12:52,160
couple of days and i'm so excited now

187
00:12:57,990 --> 00:12:55,200
to turn it over to uh mimi yang

188
00:12:58,389 --> 00:12:58,000

who is of course has been the inspiring

189
00:13:00,629 --> 00:12:58,399
leader

190
00:13:02,310 --> 00:13:00,639
of ingenuity and i just really look

191
00:13:04,870 --> 00:13:02,320
forward uh to hearing

192
00:13:06,389 --> 00:13:04,880
from you now mimi thank you thank you

193
00:13:08,629 --> 00:13:06,399
thomas

194
00:13:09,990 --> 00:13:08,639
well the moment that our team has been

195
00:13:14,629 --> 00:13:10,000
waiting for

196
00:13:17,670 --> 00:13:14,639
is almost here sunday the first flight

197
00:13:18,150 --> 00:13:17,680
you know each world gets only one first

198
00:13:20,310 --> 00:13:18,160
flight

199
00:13:21,269 --> 00:13:20,320
so as thomas mentioned the wright

200
00:13:24,150 --> 00:13:21,279
brothers achieved

201
00:13:24,949 --> 00:13:24,160
the first flight on earth ingenuity is

202
00:13:28,790 --> 00:13:24,959
poised

203
00:13:31,190 --> 00:13:28,800
to go for being the first for mars

204
00:13:33,190 --> 00:13:31,200
it's going to be a flight experiment

205
00:13:36,230 --> 00:13:33,200
flight experiments are as old as

206
00:13:36,710 --> 00:13:36,240
flying right so the wright brothers uh

207
00:13:39,189 --> 00:13:36,720
first

208
00:13:40,550 --> 00:13:39,199
successful control flight uh powered

209
00:13:41,350 --> 00:13:40,560
controlled flight was a flight

210
00:13:44,389 --> 00:13:41,360
experiment

211
00:13:46,629 --> 00:13:44,399
uh next picture please everybody is

212
00:13:49,430 --> 00:13:46,639
familiar with this uh picture

213
00:13:51,430 --> 00:13:49,440

and uh that was uh wilbur wright of

214
00:13:54,550 --> 00:13:51,440
performing this flight successfully

215
00:13:56,230 --> 00:13:54,560
on december 17th 1903.

216
00:13:57,670 --> 00:13:56,240
few people know that that wasn't his

217
00:13:59,829 --> 00:13:57,680
first attempt

218
00:14:01,829 --> 00:13:59,839
so in the next picture showing not

219
00:14:05,189 --> 00:14:01,839
successful flight

220
00:14:08,310 --> 00:14:05,199
that was taken in on december

221
00:14:11,750 --> 00:14:08,320
14th three days before in 1903

222
00:14:15,509 --> 00:14:11,760
and the wright brothers did not succeed

223
00:14:18,230 --> 00:14:15,519
well history tells us that the

224
00:14:19,509 --> 00:14:18,240
orville and wilbur took this setback as

225
00:14:21,509 --> 00:14:19,519
like true engineers

226
00:14:22,870 --> 00:14:21,519
went back looked at the data reviewed

227
00:14:24,710 --> 00:14:22,880
the data

228
00:14:27,189 --> 00:14:24,720
confirmed that their fundamental

229
00:14:29,509 --> 00:14:27,199
understanding of flying was correct

230
00:14:30,710 --> 00:14:29,519
make the tweaks went for it again and

231
00:14:33,430 --> 00:14:30,720
succeeded

232
00:14:34,629 --> 00:14:33,440
i love this picture because it's truly a

233
00:14:37,829 --> 00:14:34,639
flight experiment

234
00:14:38,629 --> 00:14:37,839
and in fact um that night after the

235
00:14:41,670 --> 00:14:38,639
failure

236
00:14:44,389 --> 00:14:41,680
uh wilbur wrote that there is now no

237
00:14:47,030 --> 00:14:44,399
question of final success

238
00:14:49,350 --> 00:14:47,040

so they knew he knew that they had

239
00:14:51,990 --> 00:14:49,360
nailed the fundamental understanding

240
00:14:53,269 --> 00:14:52,000
and you know we have to test to advance

241
00:14:55,750 --> 00:14:53,279
and that is what uh

242
00:14:58,150 --> 00:14:55,760
building first-of-a-kind systems and

243
00:15:01,590 --> 00:14:58,160
flight experiments are all about

244
00:15:03,670 --> 00:15:01,600
design test learn from the design

245
00:15:05,110 --> 00:15:03,680
adjust the design test repeat until

246
00:15:07,670 --> 00:15:05,120
success

247
00:15:08,870 --> 00:15:07,680
and so same with ingenuity mars

248
00:15:11,430 --> 00:15:08,880
helicopter

249
00:15:13,509 --> 00:15:11,440
we started with the fundamental question

250
00:15:15,509 --> 00:15:13,519
really serious question of is it really

251
00:15:18,470 --> 00:15:15,519
possible whether it's possible

252
00:15:19,990 --> 00:15:18,480
to fly a helicopter on mars and it's

253
00:15:23,189 --> 00:15:20,000
challenging

254
00:15:24,870 --> 00:15:23,199
for many different reasons for

255
00:15:26,710 --> 00:15:24,880
most important of all the atmosphere at

256
00:15:28,470 --> 00:15:26,720
mars is extremely thin

257
00:15:31,110 --> 00:15:28,480
right it's one percent compared to the

258
00:15:34,629 --> 00:15:31,120
atmosphere we have on earth

259
00:15:35,590 --> 00:15:34,639
and it is very cold at night the vehicle

260
00:15:37,990 --> 00:15:35,600
we send there

261
00:15:40,710 --> 00:15:38,000
has to survive cold nights on its own it

262
00:15:42,069 --> 00:15:40,720
has to charge itself and the winds are

263
00:15:44,389 --> 00:15:42,079

new to us

264
00:15:46,150 --> 00:15:44,399
on top of it all this flight experiment

265
00:15:49,110 --> 00:15:46,160
that we are performing at mars

266
00:15:50,629 --> 00:15:49,120
has to be operated from back here on

267
00:15:52,790 --> 00:15:50,639
earth

268
00:15:54,389 --> 00:15:52,800
all right so we took on we start with

269
00:15:56,870 --> 00:15:54,399
the analysis that showed

270
00:15:57,910 --> 00:15:56,880
how much we can lift and then we took

271
00:16:01,189 --> 00:15:57,920
systematic

272
00:16:02,949 --> 00:16:01,199
incremental design test

273
00:16:04,470 --> 00:16:02,959
and feed in to the next level of

274
00:16:07,430 --> 00:16:04,480
designing and tests

275
00:16:08,710 --> 00:16:07,440
and from showing the capability of lift

276
00:16:12,230 --> 00:16:08,720
with a prototype vehicle

277
00:16:14,310 --> 00:16:12,240
in simulated mars atmospheric um

278
00:16:15,430 --> 00:16:14,320
environment in the 25 foot chamber here

279
00:16:17,910 --> 00:16:15,440
at jpl

280
00:16:19,269 --> 00:16:17,920
we showed lyft from then on we went to

281
00:16:21,829 --> 00:16:19,279
show that we can build

282
00:16:22,629 --> 00:16:21,839
uh we we demonstrated first full flight

283
00:16:24,550 --> 00:16:22,639
controlled

284
00:16:26,870 --> 00:16:24,560
control flight power flight in our

285
00:16:29,509 --> 00:16:26,880
chamber in 2016.

286
00:16:30,870 --> 00:16:29,519
we went on to then develop the full up

287
00:16:33,590 --> 00:16:30,880
model

288
00:16:34,069 --> 00:16:33,600

that is needed for the system to need to

289
00:16:36,790 --> 00:16:34,079
fly

290
00:16:38,230 --> 00:16:36,800
a test at mars and as we call it the

291
00:16:39,670 --> 00:16:38,240
engineering development model we

292
00:16:42,069 --> 00:16:39,680
demonstrated

293
00:16:43,990 --> 00:16:42,079
full success test flight we flew it

294
00:16:48,389 --> 00:16:44,000
successfully in our chamber

295
00:16:52,150 --> 00:16:48,399
in 2018 and then we built ingenuity

296
00:16:54,550 --> 00:16:52,160
which we flew in our chamber in uh 2019.

297
00:16:55,749 --> 00:16:54,560
so this is the result the picture you

298
00:16:59,110 --> 00:16:55,759
see

299
00:17:00,150 --> 00:16:59,120
is a close-up photo of uh ingenuity mars

300
00:17:02,949 --> 00:17:00,160
helicopter

301
00:17:04,390 --> 00:17:02,959
taken very shortly before we packed it

302
00:17:07,590 --> 00:17:04,400
to be shipped to florida

303
00:17:10,069 --> 00:17:07,600
to be integrated onto perseverance rover

304
00:17:11,029 --> 00:17:10,079
thomas actually you were in the lab

305
00:17:14,309 --> 00:17:11,039
visiting us

306
00:17:15,350 --> 00:17:14,319
the day this photo was taken so this is

307
00:17:18,549 --> 00:17:15,360
one of my four

308
00:17:22,150 --> 00:17:18,559
favorite pictures uh on this um on this

309
00:17:22,710 --> 00:17:22,160
uh project so this little four pound

310
00:17:27,189 --> 00:17:22,720
vehicle

311
00:17:29,430 --> 00:17:27,199
pound to date as we speak

312
00:17:31,190 --> 00:17:29,440
has been surviving on its own the cold

313
00:17:33,029 --> 00:17:31,200

nights the temperatures there get down

314
00:17:36,230 --> 00:17:33,039
to minus 90 degrees centigrade

315
00:17:38,230 --> 00:17:36,240
like minus 130 degrees fahrenheit

316
00:17:39,990 --> 00:17:38,240
it's been surviving its own it has been

317
00:17:41,590 --> 00:17:40,000
successfully charging

318
00:17:44,070 --> 00:17:41,600
it's recharging its battery during the

319
00:17:45,270 --> 00:17:44,080
day it has been communicating to a space

320
00:17:48,230 --> 00:17:45,280
station that resides

321
00:17:49,510 --> 00:17:48,240
on the rover ultimately exchanging

322
00:17:51,669 --> 00:17:49,520
information with us

323
00:17:53,270 --> 00:17:51,679
and we have fully confirmed that it has

324
00:17:56,390 --> 00:17:53,280
enough energy and power

325
00:17:58,310 --> 00:17:56,400
to perform this flight at mars and the

326
00:18:00,470 --> 00:17:58,320
flight of mars is high power peak powers

327
00:18:03,750 --> 00:18:00,480
exceed 350 watts

328
00:18:05,110 --> 00:18:03,760
so the vehicle is set and the last time

329
00:18:08,230 --> 00:18:05,120
ingenuity flew

330
00:18:09,750 --> 00:18:08,240
was here at jpl in the 25 foot chamber

331
00:18:11,990 --> 00:18:09,760
with us with our team

332
00:18:13,669 --> 00:18:12,000
and at that time we said you know next

333
00:18:17,669 --> 00:18:13,679
time ingenuity flies

334
00:18:20,630 --> 00:18:17,679
it will be at mars next please

335
00:18:21,270 --> 00:18:20,640
next is a picture of our team oh there

336
00:18:25,190 --> 00:18:21,280
it is

337
00:18:30,710 --> 00:18:25,200
at mars you see it on its own

338
00:18:35,510 --> 00:18:33,669

is a picture of the helicopter team now

339
00:18:35,990 --> 00:18:35,520
not everybody could make to this photo

340
00:18:39,909 --> 00:18:36,000
session

341
00:18:43,270 --> 00:18:39,919
it's a large team and across the country

342
00:18:44,150 --> 00:18:43,280
here a team at jpl nasa ames nasa

343
00:18:47,350 --> 00:18:44,160
langley

344
00:18:50,870 --> 00:18:47,360
industrial partners aerovarmint qualcomm

345
00:18:53,590 --> 00:18:50,880
solero lockheed others and

346
00:18:54,710 --> 00:18:53,600
we are really proud to have achieved to

347
00:18:56,630 --> 00:18:54,720
where we are

348
00:18:59,190 --> 00:18:56,640
at this moment and we're looking forward

349
00:19:02,230 --> 00:18:59,200
to our first flight attempt on sunday

350
00:19:03,430 --> 00:19:02,240
so on behalf of our whole team uh thomas

351
00:19:06,789 --> 00:19:03,440
i'd like to thank

352
00:19:09,190 --> 00:19:06,799
nasa um and every home

353
00:19:09,990 --> 00:19:09,200
organization for letting us their mighty

354
00:19:12,549 --> 00:19:10,000
things and in this

355
00:19:14,710 --> 00:19:12,559
case daring to fly on another planet

356
00:19:17,990 --> 00:19:14,720
really thank you

357
00:19:19,590 --> 00:19:18,000
and now recapping the t the the goals of

358
00:19:21,270 --> 00:19:19,600
the mars helicopter technology

359
00:19:23,909 --> 00:19:21,280
demonstration

360
00:19:24,870 --> 00:19:23,919
is to meet nasa's agency level

361
00:19:27,750 --> 00:19:24,880
objectives

362
00:19:29,350 --> 00:19:27,760
and there are three the first is to

363
00:19:32,390 --> 00:19:29,360

demonstrate on earth

364
00:19:35,190 --> 00:19:32,400
that it is possible to fly

365
00:19:36,470 --> 00:19:35,200
a controlled power flight on mars and we

366
00:19:39,430 --> 00:19:36,480
have done that

367
00:19:41,270 --> 00:19:39,440
and the second objective we have is to

368
00:19:44,150 --> 00:19:41,280
actually fly at mars

369
00:19:45,430 --> 00:19:44,160
we're within a few days of doing that

370
00:19:48,710 --> 00:19:45,440
and third is to return

371
00:19:50,630 --> 00:19:48,720
data to inform engineers developing the

372
00:19:51,190 --> 00:19:50,640
future generations of helicopters for

373
00:19:53,750 --> 00:19:51,200
mars

374
00:19:54,630 --> 00:19:53,760
we have started receiving data and so

375
00:19:56,070 --> 00:19:54,640
far so good

376
00:19:57,830 --> 00:19:56,080
and we're looking forward to the data

377
00:19:59,909 --> 00:19:57,840
coming up so now

378
00:20:01,830 --> 00:19:59,919
turning our attention to the first

379
00:20:04,630 --> 00:20:01,840
flight attempt on sunday

380
00:20:05,590 --> 00:20:04,640
so up to now we have been talking to

381
00:20:12,070 --> 00:20:05,600
ingenuity

382
00:20:13,669 --> 00:20:12,080
perfectly by perseverance rover to the

383
00:20:16,710 --> 00:20:13,679
surface

384
00:20:19,270 --> 00:20:16,720
and we have checked out ingenuity's

385
00:20:20,950 --> 00:20:19,280
energy profile very healthy very good

386
00:20:22,070 --> 00:20:20,960
we're happy the thermal models have been

387
00:20:23,510 --> 00:20:22,080
checked out

388
00:20:26,230 --> 00:20:23,520

the sensors have been turned on

389
00:20:28,390 --> 00:20:26,240
computers are on operating well

390
00:20:29,590 --> 00:20:28,400
our rotor the blades have been released

391
00:20:32,070 --> 00:20:29,600
and we have finished

392
00:20:33,990 --> 00:20:32,080
testing the rotor operating low speed

393
00:20:36,950 --> 00:20:34,000
spin at 50 rpm

394
00:20:38,549 --> 00:20:36,960
so we have one uh final checkout test

395
00:20:41,350 --> 00:20:38,559
and that's scheduled for today

396
00:20:43,830 --> 00:20:41,360
and best to spin it full speed uh spin

397
00:20:46,789 --> 00:20:43,840
the rotors full speed to the flight rpm

398
00:20:47,510 --> 00:20:46,799
and uh after that uh we will be set to

399
00:20:54,630 --> 00:20:47,520
go

400
00:20:57,510 --> 00:20:54,640
so uh we have chosen uh the time

401
00:20:58,549 --> 00:20:57,520
of the first flight to be 12 30 pm mars

402
00:21:01,350 --> 00:20:58,559
local time

403
00:21:03,270 --> 00:21:01,360
and this time is picked between

404
00:21:05,510 --> 00:21:03,280
assessment of wind conditions

405
00:21:06,789 --> 00:21:05,520
and assessment of having sufficient

406
00:21:09,029 --> 00:21:06,799
energy and power

407
00:21:10,149 --> 00:21:09,039
for engineering to perform a robust

408
00:21:12,390 --> 00:21:10,159
flight

409
00:21:14,630 --> 00:21:12,400
so in parallel we have been

410
00:21:17,909 --> 00:21:14,640
communicating with the meta team

411
00:21:18,870 --> 00:21:17,919
on the mars weather at mars meta is the

412
00:21:22,230 --> 00:21:18,880
weather instrument

413
00:21:24,230 --> 00:21:22,240

on the perseverance rover initial uh

414
00:21:28,070 --> 00:21:24,240
metadata indicates that

415
00:21:30,549 --> 00:21:28,080
we could encounter winds higher than

416
00:21:32,310 --> 00:21:30,559
what we were able to test on earth but

417
00:21:34,230 --> 00:21:32,320
there's also probability it could be

418
00:21:35,669 --> 00:21:34,240
less than what we tested on earth

419
00:21:38,470 --> 00:21:35,679
there is uncertainty in the predicted

420
00:21:41,590 --> 00:21:38,480
range but our simulations

421
00:21:43,590 --> 00:21:41,600
show that we are able to uh the system

422
00:21:46,549 --> 00:21:43,600
the closely controlled flight system

423
00:21:47,669 --> 00:21:46,559
is resilient to this range of winds but

424
00:21:50,549 --> 00:21:47,679
that's an example of

425
00:21:53,110 --> 00:21:50,559
exactly why we are testing at mars

426
00:21:55,750 --> 00:21:53,120
performing this flight experiment

427
00:21:57,270 --> 00:21:55,760
so we have carefully designed we have

428
00:21:58,950 --> 00:21:57,280
carefully tested on earth

429
00:22:00,630 --> 00:21:58,960
we have been checking out carefully on

430
00:22:02,230 --> 00:22:00,640
mars up to now

431
00:22:03,669 --> 00:22:02,240
and it's time to attempt the first

432
00:22:06,710 --> 00:22:03,679
flight and we

433
00:22:08,070 --> 00:22:06,720
will test prove and learn regardless of

434
00:22:11,750 --> 00:22:08,080
what the outcome is

435
00:22:14,870 --> 00:22:11,760
in this first attempt so for

436
00:22:17,990 --> 00:22:14,880
sunday there are four possible outcomes

437
00:22:20,710 --> 00:22:18,000
the first is full success second

438
00:22:22,870 --> 00:22:20,720

partial success third could be

439
00:22:24,390 --> 00:22:22,880
insufficient or no data coming back

440
00:22:26,549 --> 00:22:24,400
which means we'll have to take more time

441
00:22:29,830 --> 00:22:26,559
to figure out what's happened

442
00:22:33,990 --> 00:22:29,840
or it could be failure so please join

443
00:22:37,270 --> 00:22:34,000
us and regardless we will learn

444
00:22:40,230 --> 00:22:37,280
whether it's success failure interim but

445
00:22:41,909 --> 00:22:40,240
one thing is for sure you know we have

446
00:22:43,750 --> 00:22:41,919
done everything we can and if we don't

447
00:22:46,549 --> 00:22:43,760
make that first attempt for sure

448
00:22:48,230 --> 00:22:46,559
we will not make progress forward so

449
00:22:49,990 --> 00:22:48,240
with that to describe more of what's

450
00:22:53,110 --> 00:22:50,000
coming up i'd like to hand it over to

451
00:22:56,789 --> 00:22:54,950
well thank you mimi and the team of

452
00:22:58,870 --> 00:22:56,799
course is very excited to be looking

453
00:23:00,470 --> 00:22:58,880
forward to this first flight

454
00:23:02,789 --> 00:23:00,480
you know we've has we have spent the

455
00:23:05,270 --> 00:23:02,799
last year planning and practicing and

456
00:23:06,789 --> 00:23:05,280
and uh understanding what we need to do

457
00:23:08,470 --> 00:23:06,799
to do the first flight and of course

458
00:23:10,310 --> 00:23:08,480
the team was very excited for

459
00:23:11,430 --> 00:23:10,320
perseverance gently landing us on the

460
00:23:13,510 --> 00:23:11,440
surface

461
00:23:15,510 --> 00:23:13,520
we looked for a site which thankfully

462
00:23:17,909 --> 00:23:15,520
was only 20 or 30 meters away from the

463
00:23:20,630 --> 00:23:17,919

octavia butler landing site

464
00:23:21,669 --> 00:23:20,640
and we've since we've dropped we've been

465
00:23:23,590 --> 00:23:21,679
working our way through these

466
00:23:24,950 --> 00:23:23,600
commissioning activities to check out

467
00:23:27,750 --> 00:23:24,960
the helicopter

468
00:23:28,149 --> 00:23:27,760
to do some calisthenics to make sure all

469
00:23:32,710 --> 00:23:28,159
the

470
00:23:34,149 --> 00:23:32,720
are working as mimi mentioned

471
00:23:36,470 --> 00:23:34,159
and so finally we're reaching that

472
00:23:38,470 --> 00:23:36,480
culmination of all of that testing

473
00:23:39,590 --> 00:23:38,480
and the helicopter is good it's looking

474
00:23:41,510 --> 00:23:39,600
healthy

475
00:23:42,870 --> 00:23:41,520
we're very excited that the energy

476
00:23:46,230 --> 00:23:42,880
levels are where they need to be

477
00:23:48,390 --> 00:23:46,240
to fly and we're finishing off these

478
00:23:51,269 --> 00:23:48,400
last commissioning activities

479
00:23:53,269 --> 00:23:51,279
and last night we did our 50 rpm spin

480
00:23:55,750 --> 00:23:53,279
where we spun the blades very slowly

481
00:23:58,070 --> 00:23:55,760
and carefully and exercised the servos

482
00:23:59,830 --> 00:23:58,080
to control the angle of the blades

483
00:24:01,350 --> 00:23:59,840
and that was very successful and we have

484
00:24:03,909 --> 00:24:01,360
here a quick video that the

485
00:24:06,149 --> 00:24:03,919
mass cam z took of those of the

486
00:24:08,710 --> 00:24:06,159
helicopter spinning in the distance

487
00:24:10,230 --> 00:24:08,720
so from there the rover was about 40

488
00:24:11,430 --> 00:24:10,240

meters away

489
00:24:13,669 --> 00:24:11,440
and so we're able to look at the

490
00:24:14,630 --> 00:24:13,679
telemetry in very good detail and verify

491
00:24:16,630 --> 00:24:14,640
that the

492
00:24:19,750 --> 00:24:16,640
the blades moved and the and the blades

493
00:24:22,230 --> 00:24:19,760
spun as expected and it looks very good

494
00:24:24,070 --> 00:24:22,240
so what's it gonna be when we fly so the

495
00:24:24,549 --> 00:24:24,080
flight as mimi mentioned will happen at

496
00:24:27,830 --> 00:24:24,559
12

497
00:24:30,470 --> 00:24:27,840
30 in the afternoon on mars time

498
00:24:32,070 --> 00:24:30,480
which will be about 8 pm on earth time

499
00:24:34,549 --> 00:24:32,080
on sunday

500
00:24:36,470 --> 00:24:34,559
and then later on in the evening the

501
00:24:38,070 --> 00:24:36,480
data will be relayed back to earth

502
00:24:40,549 --> 00:24:38,080
by the perseverance rover through an

503
00:24:42,470 --> 00:24:40,559
orbiter and then we will

504
00:24:44,950 --> 00:24:42,480
be waiting here in the control centers

505
00:24:47,590 --> 00:24:44,960
at nasa for that data to come in

506
00:24:48,470 --> 00:24:47,600
we're expecting that data around 12

507
00:24:51,110 --> 00:24:48,480
midnight

508
00:24:52,549 --> 00:24:51,120
early monday morning and so what's the

509
00:24:54,950 --> 00:24:52,559
first flight going to be

510
00:24:56,549 --> 00:24:54,960
it's going to be a very careful flight

511
00:24:58,630 --> 00:24:56,559
just to do the very first checkout

512
00:25:01,190 --> 00:24:58,640
because it'll be our first flight

513
00:25:03,350 --> 00:25:01,200

and we're gonna we're gonna lift off

514
00:25:05,990 --> 00:25:03,360
we're gonna go up to about three meters

515
00:25:07,110 --> 00:25:06,000
we're gonna rotate in the direction of

516
00:25:09,029 --> 00:25:07,120
the rover

517
00:25:10,870 --> 00:25:09,039
and we're gonna take a picture and then

518
00:25:12,310 --> 00:25:10,880
we're gonna settle back down

519
00:25:14,789 --> 00:25:12,320
the whole flight from the moment the

520
00:25:17,269 --> 00:25:14,799
blades spin up until we land again we'll

521
00:25:19,110 --> 00:25:17,279
be about 40 seconds worth of time

522
00:25:21,029 --> 00:25:19,120
that's the time we felt safe doing it on

523
00:25:22,070 --> 00:25:21,039
our first flight given the energy levels

524
00:25:23,669 --> 00:25:22,080
that we're seeing

525
00:25:25,510 --> 00:25:23,679
and we want to make the very first

526
00:25:26,950 --> 00:25:25,520
flight a safe one

527
00:25:28,789 --> 00:25:26,960
as you can see in the accompanying

528
00:25:30,549 --> 00:25:28,799
animation that's what the flight will

529
00:25:32,149 --> 00:25:30,559
look like

530
00:25:33,590 --> 00:25:32,159
so one of the nice things about the

531
00:25:36,789 --> 00:25:33,600
helicopter is that

532
00:25:37,430 --> 00:25:36,799
it has cameras on board and we have a

533
00:25:39,110 --> 00:25:37,440
downward

534
00:25:41,029 --> 00:25:39,120
pointing black and white camera that we

535
00:25:43,269 --> 00:25:41,039
use to do our navigation

536
00:25:44,710 --> 00:25:43,279
it's fused with other sensors like an

537
00:25:47,269 --> 00:25:44,720
inertial guidance sensor

538
00:25:49,350 --> 00:25:47,279

and an altimeter and as we're flying

539
00:25:50,470 --> 00:25:49,360
we're taking pictures 30 times a second

540
00:25:52,870 --> 00:25:50,480
of the surface

541
00:25:54,630 --> 00:25:52,880
and the software is detecting features

542
00:25:56,149 --> 00:25:54,640
and then as the helicopter moves those

543
00:25:58,149 --> 00:25:56,159
features move with it

544
00:25:59,190 --> 00:25:58,159
and the helicopter can do an estimate of

545
00:26:00,870 --> 00:25:59,200
what those

546
00:26:03,269 --> 00:26:00,880
what the rate and direction of the

547
00:26:05,590 --> 00:26:03,279
helicopter motion is

548
00:26:06,950 --> 00:26:05,600
so that black and white camera is our

549
00:26:07,909 --> 00:26:06,960
primary camera that we use for

550
00:26:10,390 --> 00:26:07,919
navigation

551
00:26:12,470 --> 00:26:10,400
here is a picture that we took downward

552
00:26:14,149 --> 00:26:12,480
facing on the day that we dropped

553
00:26:15,669 --> 00:26:14,159
you can see it's slightly overexposed

554
00:26:17,750 --> 00:26:15,679
but we we've been tuning it over the

555
00:26:19,350 --> 00:26:17,760
last few saws to get better pictures

556
00:26:20,630 --> 00:26:19,360
but that's really the view what the

557
00:26:22,710 --> 00:26:20,640
helicopter is going to see while it's

558
00:26:24,789 --> 00:26:22,720
flying and it'll pick out those features

559
00:26:26,310 --> 00:26:24,799
on the ground the rocks that was one of

560
00:26:27,909 --> 00:26:26,320
the reasons we selected this terrain is

561
00:26:29,190 --> 00:26:27,919
because the features are very nice for

562
00:26:31,750 --> 00:26:29,200
that feature tracking

563
00:26:34,310 --> 00:26:31,760

so as those features drift the software

564
00:26:37,190 --> 00:26:34,320
can detect those drip that drift

565
00:26:38,549 --> 00:26:37,200
secondly we have a 13 megapixel color

566
00:26:40,230 --> 00:26:38,559
camera that's pointing towards the

567
00:26:41,669 --> 00:26:40,240
horizon

568
00:26:43,350 --> 00:26:41,679
and that picture will take a few of

569
00:26:45,190 --> 00:26:43,360
those pictures during each flight so

570
00:26:47,110 --> 00:26:45,200
that we'll get a live

571
00:26:49,590 --> 00:26:47,120
picture as we're aloft and here's a

572
00:26:52,070 --> 00:26:49,600
picture underneath the rover

573
00:26:53,590 --> 00:26:52,080
on the day that we dropped now there was

574
00:26:54,630 --> 00:26:53,600
a picture that went out that was a low

575
00:26:55,990 --> 00:26:54,640
resolution

576
00:26:57,510 --> 00:26:56,000
version of this picture but in the

577
00:26:57,909 --> 00:26:57,520
meantime we've been able to retrieve the

578
00:27:01,110 --> 00:26:57,919
high

579
00:27:02,230 --> 00:27:01,120
full glory 13 megapixel picture and that

580
00:27:04,789 --> 00:27:02,240
will be out on the

581
00:27:06,470 --> 00:27:04,799
nasa website soon so this is kind of an

582
00:27:08,230 --> 00:27:06,480
idea of what what kind of resolution

583
00:27:09,909 --> 00:27:08,240
that we'll get from those pictures as we

584
00:27:12,950 --> 00:27:09,919
take them

585
00:27:14,950 --> 00:27:12,960
so what we'll be doing the night of the

586
00:27:16,789 --> 00:27:14,960
flight when the data comes in

587
00:27:18,950 --> 00:27:16,799
we have our downlink team that will be

588
00:27:20,389 --> 00:27:18,960

watching carefully as that relay happens

589
00:27:23,190 --> 00:27:20,399
from the rover

590
00:27:24,870 --> 00:27:23,200
through the mro orbiter back to earth

591
00:27:26,630 --> 00:27:24,880
we'll see the data show up in the data

592
00:27:28,789 --> 00:27:26,640
center and then our downlink engineers

593
00:27:30,310 --> 00:27:28,799
will start to decode all that data

594
00:27:31,990 --> 00:27:30,320
and the first thing we want to do is to

595
00:27:34,549 --> 00:27:32,000
verify that we got the data

596
00:27:36,710 --> 00:27:34,559
correctly and at that point once we

597
00:27:38,630 --> 00:27:36,720
confirm that the data has arrived

598
00:27:39,990 --> 00:27:38,640
we will turn it over to hovard grip who

599
00:27:41,750 --> 00:27:40,000
is our chief pilot

600
00:27:43,110 --> 00:27:41,760
and he will look for very specific

601
00:27:44,789 --> 00:27:43,120
events

602
00:27:46,470 --> 00:27:44,799
in that data that indicate that the

603
00:27:49,029 --> 00:27:46,480
helicopter took off

604
00:27:49,590 --> 00:27:49,039
did the hover did the rotation and then

605
00:27:53,110 --> 00:27:49,600
came back

606
00:27:54,549 --> 00:27:53,120
down and landed successfully so

607
00:27:56,710 --> 00:27:54,559
that's the first thing we'll look at and

608
00:27:58,870 --> 00:27:56,720
then what we'll do is we'll jump to our

609
00:27:59,990 --> 00:27:58,880
our altimeter data we have a laser

610
00:28:03,750 --> 00:28:00,000
altimeter

611
00:28:06,549 --> 00:28:03,760
data to see that we rose

612
00:28:07,990 --> 00:28:06,559
hovered and then came back down and at

613
00:28:10,549 --> 00:28:08,000

that point

614
00:28:11,990 --> 00:28:10,559
we'll be able to confirm yes we did

615
00:28:14,789 --> 00:28:12,000
really take off

616
00:28:16,549 --> 00:28:14,799
and we'll be able to then look at images

617
00:28:17,669 --> 00:28:16,559
that black and white navigation camera

618
00:28:19,990 --> 00:28:17,679
that i mentioned

619
00:28:21,590 --> 00:28:20,000
it will be taking these downward

620
00:28:23,750 --> 00:28:21,600
pictures and we'll be taking some

621
00:28:25,750 --> 00:28:23,760
images as we come down that help us

622
00:28:27,190 --> 00:28:25,760
check for sure where we landed

623
00:28:28,870 --> 00:28:27,200
and so we'll be able to see that on the

624
00:28:30,310 --> 00:28:28,880
day of the flight

625
00:28:32,230 --> 00:28:30,320
the color camera pictures that i

626
00:28:33,830 --> 00:28:32,240
mentioned we will be downlinking them

627
00:28:35,430 --> 00:28:33,840
the day after the flight so we're very

628
00:28:37,350 --> 00:28:35,440
we'll be very excited to see what

629
00:28:38,789 --> 00:28:37,360
kind of picture was taken during that

630
00:28:41,110 --> 00:28:38,799
flight time

631
00:28:43,190 --> 00:28:41,120
once you've seen the altimeter and the

632
00:28:44,070 --> 00:28:43,200
helicopter team is super excited because

633
00:28:46,389 --> 00:28:44,080
we've confirmed

634
00:28:47,830 --> 00:28:46,399
that we did that first flight then we

635
00:28:49,830 --> 00:28:47,840
should be able to see some

636
00:28:51,269 --> 00:28:49,840
imagery from the rover itself the rover

637
00:28:54,230 --> 00:28:51,279
is going to use that

638
00:28:55,110 --> 00:28:54,240

magnificent zcam instrument to attempt

639
00:28:57,430 --> 00:28:55,120
to take video

640
00:28:59,590 --> 00:28:57,440
during the flight we've been practicing

641
00:29:02,789 --> 00:28:59,600
that over the last few saws with the

642
00:29:04,630 --> 00:29:02,799
blade release and the 50 rpm spin

643
00:29:06,149 --> 00:29:04,640
to try to synchronize our timing and so

644
00:29:06,950 --> 00:29:06,159
far it's gone really really well so we

645
00:29:10,070 --> 00:29:06,960
thank the

646
00:29:11,430 --> 00:29:10,080
mass cam z team for that and so

647
00:29:13,269 --> 00:29:11,440
on the day of the flight when we're

648
00:29:15,510 --> 00:29:13,279
downlinking that data once we confirm

649
00:29:17,110 --> 00:29:15,520
that we flew via that altimeter data

650
00:29:18,870 --> 00:29:17,120
then we can turn it over to the rower

651
00:29:21,029 --> 00:29:18,880
team and see what kind of imagery they

652
00:29:22,149 --> 00:29:21,039
got for the actual flight from the rover

653
00:29:23,510 --> 00:29:22,159
itself so

654
00:29:25,669 --> 00:29:23,520
we're really excited it could be an

655
00:29:28,149 --> 00:29:25,679
amazing day we're all

656
00:29:29,990 --> 00:29:28,159
nervous but we have confidence that we

657
00:29:31,430 --> 00:29:30,000
put in the work and the time

658
00:29:33,190 --> 00:29:31,440
and we have the right people to do the

659
00:29:34,950 --> 00:29:33,200
job

660
00:29:36,870 --> 00:29:34,960
and so at this time i want to turn it

661
00:29:39,350 --> 00:29:36,880
over to amy quan and she can give

662
00:29:40,070 --> 00:29:39,360
some history on how we actually tested

663
00:29:47,909 --> 00:29:40,080

the helicopter

664
00:29:51,430 --> 00:29:49,750
so my job as the test conductor for the

665
00:29:51,830 --> 00:29:51,440
mars helicopter was to make mars on

666
00:29:53,110 --> 00:29:51,840
earth

667
00:29:55,510 --> 00:29:53,120
and enough of it so that we could

668
00:29:57,430 --> 00:29:55,520
actually fly our helicopter in it

669
00:29:59,269 --> 00:29:57,440
we needed to test ingenuity because it's

670
00:30:01,110 --> 00:29:59,279
very difficult to fly on mars

671
00:30:02,789 --> 00:30:01,120
the main reason is that the atmosphere

672
00:30:04,950 --> 00:30:02,799
is very very thin

673
00:30:07,110 --> 00:30:04,960
it's about one percent of the density of

674
00:30:08,789 --> 00:30:07,120
earth's atmosphere at sea level

675
00:30:10,710 --> 00:30:08,799
that's the equivalent of about a hundred

676
00:30:12,230 --> 00:30:10,720
thousand feet of altitude on earth

677
00:30:14,149 --> 00:30:12,240
or three times the height of mount

678
00:30:16,789 --> 00:30:14,159
everest um

679
00:30:19,190 --> 00:30:16,799
we don't generally fly things that high

680
00:30:19,669 --> 00:30:19,200
commercial airliners fly at about 35 000

681
00:30:22,070 --> 00:30:19,679
feet

682
00:30:23,029 --> 00:30:22,080
the earth record for helicopter altitude

683
00:30:24,870 --> 00:30:23,039
is about 41

684
00:30:26,630 --> 00:30:24,880
000 feet and there were some people who

685
00:30:28,070 --> 00:30:26,640
doubted we had we could generate enough

686
00:30:29,269 --> 00:30:28,080
lift to fly in that then martian

687
00:30:32,230 --> 00:30:29,279
atmosphere

688
00:30:33,830 --> 00:30:32,240

now mars has less gravity than earth but

689
00:30:36,070 --> 00:30:33,840
that's not really enough to counteract

690
00:30:37,909 --> 00:30:36,080
the effects of that thin atmosphere

691
00:30:39,269 --> 00:30:37,919
so we needed to simulate that

692
00:30:40,549 --> 00:30:39,279
environment on earth to prove to

693
00:30:43,430 --> 00:30:40,559
ourselves and others that we could

694
00:30:45,830 --> 00:30:43,440
generate enough lift to fly on mars

695
00:30:47,029 --> 00:30:45,840
we conducted a battery of tests over the

696
00:30:50,549 --> 00:30:47,039
course of five years

697
00:30:52,070 --> 00:30:50,559
starting in 2014. we started by showing

698
00:30:53,669 --> 00:30:52,080
that lift as possible

699
00:30:56,710 --> 00:30:53,679
and then we moved on to showing that we

700
00:30:58,789 --> 00:30:56,720
could have controlled autonomous flight

701
00:31:01,029 --> 00:30:58,799
with increasingly light development

702
00:31:03,029 --> 00:31:01,039
models before we moved on to

703
00:31:04,389 --> 00:31:03,039
uh testing our flight model which is the

704
00:31:06,149 --> 00:31:04,399
helicopter that's currently on the

705
00:31:07,590 --> 00:31:06,159
surface of mars and wow that's really

706
00:31:10,470 --> 00:31:07,600
amazing to say

707
00:31:11,830 --> 00:31:10,480
um for simulating mars on earth we were

708
00:31:14,230 --> 00:31:11,840
using our 25 foot

709
00:31:15,909 --> 00:31:14,240
space simulator a thermal vacuum chamber

710
00:31:18,470 --> 00:31:15,919
that we have here at jpl

711
00:31:20,070 --> 00:31:18,480
this is a chamber that we run all of our

712
00:31:21,269 --> 00:31:20,080
spacecraft through before we send them

713
00:31:23,669 --> 00:31:21,279

off into space

714
00:31:25,190 --> 00:31:23,679
for instance uh both curiosity and

715
00:31:26,789 --> 00:31:25,200
perseverance went through this chamber

716
00:31:28,070 --> 00:31:26,799
on their way to mars and the voyagers

717
00:31:31,190 --> 00:31:28,080
went through this chamber on their way

718
00:31:35,909 --> 00:31:34,149
so for our first flight in 2014 we put a

719
00:31:38,389 --> 00:31:35,919
small helicopter prototype

720
00:31:40,310 --> 00:31:38,399
in the chamber sucked all the air out

721
00:31:41,830 --> 00:31:40,320
added a little bit of carbon dioxide

722
00:31:42,549 --> 00:31:41,840
back to simulate that mars-like

723
00:31:46,789 --> 00:31:42,559
atmosphere

724
00:31:48,710 --> 00:31:46,799
mostly consists of carbon dioxide

725
00:31:50,789 --> 00:31:48,720
whereas on earth it's mostly consisting

726
00:31:52,870 --> 00:31:50,799
of nitrogen

727
00:31:54,549 --> 00:31:52,880
for that first proof of concept in 2014

728
00:31:56,470 --> 00:31:54,559
that was our first time

729
00:31:58,470 --> 00:31:56,480
attempting to fly in that mars

730
00:32:00,630 --> 00:31:58,480
atmosphere we were using an

731
00:32:02,389 --> 00:32:00,640
experienced helicopter pilot to directly

732
00:32:03,909 --> 00:32:02,399
control the helicopter

733
00:32:05,669 --> 00:32:03,919
in the video you will be able to see

734
00:32:10,149 --> 00:32:05,679
that we were able to hop around

735
00:32:13,350 --> 00:32:10,159
uh video please so hop hop and then

736
00:32:15,590 --> 00:32:13,360
wrap it on scheduled disassembly now

737
00:32:16,870 --> 00:32:15,600
that may look like a failure but similar

738
00:32:19,269 --> 00:32:16,880

to wilbur wright's

739
00:32:20,630 --> 00:32:19,279
failed flights back at kitty hawk we

740
00:32:22,389 --> 00:32:20,640
learned a whole lot

741
00:32:24,230 --> 00:32:22,399
and the biggest thing we learned was

742
00:32:26,310 --> 00:32:24,240
that we can generate sufficient lift and

743
00:32:27,990 --> 00:32:26,320
we actually can fly on mars

744
00:32:29,750 --> 00:32:28,000
granted we need to spin the rotors much

745
00:32:32,230 --> 00:32:29,760
faster than helicopter on earth would to

746
00:32:33,830 --> 00:32:32,240
generate that lift but we can do it

747
00:32:35,509 --> 00:32:33,840
the other thing we learned is that

748
00:32:37,509 --> 00:32:35,519
because of that thin atmosphere

749
00:32:39,590 --> 00:32:37,519
things happen too quickly for a human

750
00:32:41,669 --> 00:32:39,600
pilot to be able to react in time

751
00:32:42,870 --> 00:32:41,679
think about it like if you were driving

752
00:32:44,710 --> 00:32:42,880
your car and you turned the steering

753
00:32:46,230 --> 00:32:44,720
wheel the tiniest bit to stay in your

754
00:32:47,350 --> 00:32:46,240
lane and suddenly your car was doing

755
00:32:49,350 --> 00:32:47,360
donuts

756
00:32:51,110 --> 00:32:49,360
so between that and the potential

757
00:32:52,789 --> 00:32:51,120
distance between earth and mars which

758
00:32:53,590 --> 00:32:52,799
means that there is a time delay between

759
00:32:55,029 --> 00:32:53,600
when you send

760
00:32:56,710 --> 00:32:55,039
a command on earth and when it's

761
00:32:58,470 --> 00:32:56,720
received on mars

762
00:33:00,470 --> 00:32:58,480
we decided that this helicopter needed

763
00:33:03,830 --> 00:33:00,480

to be able to fly on its own

764
00:33:05,590 --> 00:33:03,840
that means we could upload a given

765
00:33:07,909 --> 00:33:05,600
flight profile to it

766
00:33:09,590 --> 00:33:07,919
um and then we tell it to go but then it

767
00:33:11,350 --> 00:33:09,600
would have to do everything else on its

768
00:33:13,669 --> 00:33:11,360
own

769
00:33:15,509 --> 00:33:13,679
so by 2018 we had incorporated all the

770
00:33:17,110 --> 00:33:15,519
data from the previous tests into

771
00:33:19,430 --> 00:33:17,120
testing this engineering model

772
00:33:21,990 --> 00:33:19,440
in our vacuum chamber um can i get this

773
00:33:24,470 --> 00:33:22,000
video please

774
00:33:25,590 --> 00:33:24,480
you'll see that the helicopter climb

775
00:33:28,950 --> 00:33:25,600
spins up

776
00:33:33,990 --> 00:33:28,960
climbs turns

777
00:33:39,350 --> 00:33:36,830
here we have the climb to that one meter

778
00:33:41,669 --> 00:33:39,360
height

779
00:33:43,750 --> 00:33:41,679
before we turn around and then do our

780
00:33:47,110 --> 00:33:43,760
translation

781
00:33:49,509 --> 00:33:47,120
and then by 2019 we took all the data

782
00:33:51,350 --> 00:33:49,519
from all our prior flights

783
00:33:52,950 --> 00:33:51,360
and tested the helicopter that's now on

784
00:33:55,750 --> 00:33:52,960
mars

785
00:33:57,509 --> 00:33:55,760
this is video from that from that test

786
00:33:59,509 --> 00:33:57,519
what you may notice is there's a string

787
00:34:01,750 --> 00:33:59,519
coming from the top of the helicopter we

788
00:34:03,430 --> 00:34:01,760

use that to mimic gravity on mars

789
00:34:05,350 --> 00:34:03,440
so it's giving the helicopter just a

790
00:34:07,110 --> 00:34:05,360
slight boost so that the rotors are only

791
00:34:08,149 --> 00:34:07,120
lifting the mars weight of that

792
00:34:09,909 --> 00:34:08,159
helicopter

793
00:34:11,349 --> 00:34:09,919
think about it like if you're helping a

794
00:34:12,790 --> 00:34:11,359
child on the playground

795
00:34:14,149 --> 00:34:12,800
cross the monkey bars and they can't

796
00:34:16,950 --> 00:34:14,159
quite hold on you're holding you're just

797
00:34:18,790 --> 00:34:16,960
giving them a slight little boost

798
00:34:20,230 --> 00:34:18,800
to successfully conduct these tests the

799
00:34:21,990 --> 00:34:20,240
helicopter team had to predict how the

800
00:34:23,030 --> 00:34:22,000
helicopter would behave in that martian

801
00:34:24,869 --> 00:34:23,040
atmosphere

802
00:34:26,550 --> 00:34:24,879
over the course of the test campaigns

803
00:34:29,030 --> 00:34:26,560
the predictions got better and better

804
00:34:32,230 --> 00:34:29,040
based on the data from the prior tests

805
00:34:33,829 --> 00:34:32,240
and we're looking forward to all the

806
00:34:35,750 --> 00:34:33,839
flight data coming back from mars this

807
00:34:37,349 --> 00:34:35,760
weekend to tell us how accurate were our

808
00:34:39,190 --> 00:34:37,359
predictions and models

809
00:34:41,030 --> 00:34:39,200
for instance if we told the helicopter

810
00:34:42,389 --> 00:34:41,040
to climb at a certain rate how fast did

811
00:34:44,069 --> 00:34:42,399
it actually climb

812
00:34:45,510 --> 00:34:44,079
we'll use that to refine the models that

813
00:34:48,149 --> 00:34:45,520

we can put into

814
00:34:49,669 --> 00:34:48,159
future aerial vehicles for mars so in

815
00:34:51,270 --> 00:34:49,679
addition to that flight data coming back

816
00:34:53,270 --> 00:34:51,280
we're also really excited about the

817
00:34:56,310 --> 00:34:53,280
possibility of getting images

818
00:34:59,430 --> 00:34:56,320
of ingenuity in flight on mars

819
00:35:01,270 --> 00:34:59,440
and elsa jensen will tell us about the

820
00:35:02,950 --> 00:35:01,280
the images that the rover is going to be

821
00:35:06,390 --> 00:35:02,960
taking also

822
00:35:07,190 --> 00:35:06,400
thank you me it gives me the chills

823
00:35:09,190 --> 00:35:07,200
sitting here

824
00:35:11,030 --> 00:35:09,200
and thinking about the fact that on

825
00:35:14,390 --> 00:35:11,040
sunday my team and i

826
00:35:17,109 --> 00:35:14,400
are going to be taking images and video

827
00:35:18,870 --> 00:35:17,119
of you guys flying on mars it is such a

828
00:35:21,990 --> 00:35:18,880
privilege to be here

829
00:35:22,950 --> 00:35:22,000
we are delighted to be supporting this

830
00:35:26,150 --> 00:35:22,960
courageous

831
00:35:28,829 --> 00:35:26,160
and inventive team and um our

832
00:35:30,950 --> 00:35:28,839
perspective really is that from the

833
00:35:34,310 --> 00:35:30,960
rover of

834
00:35:35,430 --> 00:35:34,320
sitting atop the mast with the mask mz

835
00:35:37,910 --> 00:35:35,440
cameras

836
00:35:39,910 --> 00:35:37,920
and looking at the ingenuity taking off

837
00:35:42,069 --> 00:35:39,920
for flight

838
00:35:44,710 --> 00:35:42,079

so i'm part of a small team from male

839
00:35:48,069 --> 00:35:44,720
and space science systems in san diego

840
00:35:51,190 --> 00:35:48,079
and we operate the mask mz cameras

841
00:35:54,230 --> 00:35:51,200
and we are really part of a bigger team

842
00:35:56,550 --> 00:35:54,240
for the masscam z science team that

843
00:36:00,550 --> 00:35:56,560
spans worldwide and is led

844
00:36:02,790 --> 00:36:00,560
by jim bell at arizona state university

845
00:36:04,069 --> 00:36:02,800
then of course we're part of this whole

846
00:36:07,109 --> 00:36:04,079
rover team

847
00:36:09,349 --> 00:36:07,119
there is 10 instruments on the rover and

848
00:36:10,150 --> 00:36:09,359
getting all those instruments the full

849
00:36:12,950 --> 00:36:10,160
rover

850
00:36:13,510 --> 00:36:12,960
and the helicopter to mars has been a

851
00:36:16,790 --> 00:36:13,520
huge

852
00:36:20,069 --> 00:36:16,800
team effort as you can imagine

853
00:36:20,950 --> 00:36:20,079
so um the the part that we're really

854
00:36:24,150 --> 00:36:20,960
providing here

855
00:36:27,510 --> 00:36:24,160
is looking from our perch

856
00:36:30,550 --> 00:36:27,520
two meters above six feet up and

857
00:36:33,670 --> 00:36:30,560
at the ingenuity helicopter

858
00:36:36,710 --> 00:36:33,680
that is 65 meters away on sunday

859
00:36:40,470 --> 00:36:36,720
we're just getting there just about now

860
00:36:43,510 --> 00:36:40,480
and we'll be in a safe distance

861
00:36:45,990 --> 00:36:43,520
to support and record

862
00:36:47,589 --> 00:36:46,000
this flight so we just couldn't be more

863
00:36:56,230 --> 00:36:47,599

delighted

864
00:37:02,230 --> 00:36:59,349
this um this is a selfie

865
00:37:04,069 --> 00:37:02,240
and uh what i love about this is that we

866
00:37:05,190 --> 00:37:04,079
can see the rover and the engineering

867
00:37:06,710 --> 00:37:05,200
helicopter

868
00:37:08,870 --> 00:37:06,720
next to each other you can really see

869
00:37:11,990 --> 00:37:08,880
their relationship on mars

870
00:37:14,310 --> 00:37:12,000
this is when they're five meters apart

871
00:37:15,829 --> 00:37:14,320
and you can see the the ingenuity

872
00:37:17,910 --> 00:37:15,839
helicopters there it's about

873
00:37:18,870 --> 00:37:17,920
it's about half a meter or 20 inches

874
00:37:20,950 --> 00:37:18,880
tall

875
00:37:22,390 --> 00:37:20,960
and we're close together as the selfies

876
00:37:25,190 --> 00:37:22,400
being taken

877
00:37:25,990 --> 00:37:25,200
the other thing i love about this selfie

878
00:37:28,310 --> 00:37:26,000
is that it was

879
00:37:29,750 --> 00:37:28,320
actually taken with our sister cameras

880
00:37:31,270 --> 00:37:29,760
at the end of the arm

881
00:37:33,349 --> 00:37:31,280
that's what you don't see in this image

882
00:37:35,670 --> 00:37:33,359
because it's a selfie

883
00:37:37,190 --> 00:37:35,680
but that's a camera on the watson

884
00:37:39,510 --> 00:37:37,200
cameras on the sherlock

885
00:37:41,589 --> 00:37:39,520
instrument and we built and operate that

886
00:37:42,550 --> 00:37:41,599
from male and space line systems in san

887
00:37:46,470 --> 00:37:42,560
diego as well

888
00:37:49,349 --> 00:37:46,480

to support the sherlock pi here at jpl

889
00:37:50,470 --> 00:37:49,359
it's luther beagle and we work very

890
00:37:53,510 --> 00:37:50,480
closely together

891
00:37:56,470 --> 00:37:53,520
our two teams along with the

892
00:37:58,310 --> 00:37:56,480
ingenuity team and along with the other

893
00:37:59,510 --> 00:37:58,320
science teams and the rover teams here

894
00:38:01,109 --> 00:37:59,520
at jpl

895
00:38:03,430 --> 00:38:01,119
every day we've been operating on mars

896
00:38:05,510 --> 00:38:03,440
now for 30 days and it's this

897
00:38:06,790 --> 00:38:05,520
whole choreographed dance that we do

898
00:38:10,230 --> 00:38:06,800
together

899
00:38:12,870 --> 00:38:10,240
and it's a privilege to be a part of um

900
00:38:14,230 --> 00:38:12,880
it is of course a big team and it took

901
00:38:18,069 --> 00:38:14,240
us years to get here

902
00:38:21,430 --> 00:38:18,079
to be ready for sunday and

903
00:38:24,069 --> 00:38:21,440
what i love about that is that we get to

904
00:38:26,470 --> 00:38:24,079
learn so much from each other and we're

905
00:38:28,310 --> 00:38:26,480
planning and overcoming challenges

906
00:38:29,910 --> 00:38:28,320
and some of the things we had to do to

907
00:38:32,870 --> 00:38:29,920
prepare for sunday

908
00:38:34,950 --> 00:38:32,880
was really take this high resolution

909
00:38:37,750 --> 00:38:34,960
camera you've seen the big panoramas

910
00:38:39,190 --> 00:38:37,760
we generate so much data but when you

911
00:38:41,430 --> 00:38:39,200
take a video

912
00:38:43,270 --> 00:38:41,440
you have to figure out how do i get that

913
00:38:46,230 --> 00:38:43,280

kind of data throughput

914
00:38:47,270 --> 00:38:46,240
and still take it seven six to seven

915
00:38:50,230 --> 00:38:47,280
images per

916
00:38:51,910 --> 00:38:50,240
second and how do i do that in the same

917
00:38:53,190 --> 00:38:51,920
camera that's doing these magnificent

918
00:38:55,829 --> 00:38:53,200
panoramas

919
00:38:58,310 --> 00:38:55,839
so we had to make some hard choices we

920
00:39:00,630 --> 00:38:58,320
had our systems engineer mike kaplinger

921
00:39:02,310 --> 00:39:00,640
who was just figuring out how to eke out

922
00:39:03,589 --> 00:39:02,320
every performance that we could from

923
00:39:05,510 --> 00:39:03,599
this camera

924
00:39:07,670 --> 00:39:05,520
and then when we came up with command

925
00:39:09,349 --> 00:39:07,680
sequences that's my team's job

926
00:39:10,790 --> 00:39:09,359
those will be tested in the test bed

927
00:39:13,670 --> 00:39:10,800
here jpl by kim

928
00:39:14,310 --> 00:39:13,680
saxon our instrument engineer who spent

929
00:39:17,910 --> 00:39:14,320
many

930
00:39:20,710 --> 00:39:17,920
nights and weekends in the test bed and

931
00:39:22,230 --> 00:39:20,720
that allowed us to learn as amy was

932
00:39:25,589 --> 00:39:22,240
explaining what not to do

933
00:39:30,630 --> 00:39:25,599
and also what to do so if i could have

934
00:39:34,710 --> 00:39:33,030
this is um starting to set up what we

935
00:39:37,750 --> 00:39:34,720
can expect on sunday

936
00:39:39,910 --> 00:39:37,760
so this is a computer made graphic right

937
00:39:42,069 --> 00:39:39,920
this is what we simulate before we

938
00:39:43,750 --> 00:39:42,079

actually take the images and the videos

939
00:39:45,510 --> 00:39:43,760
so what we're looking for is figuring

940
00:39:48,150 --> 00:39:45,520
out okay is this going to work

941
00:39:48,870 --> 00:39:48,160
what you see here is a little bit of the

942
00:39:50,870 --> 00:39:48,880
rover

943
00:39:52,470 --> 00:39:50,880
in the foreground and we're looking out

944
00:39:56,230 --> 00:39:52,480
towards ingenuity

945
00:39:58,790 --> 00:39:56,240
these 65 meters or 200 feet away

946
00:39:59,349 --> 00:39:58,800
and it looks this red frame that you're

947
00:40:01,750 --> 00:39:59,359
seeing

948
00:40:03,670 --> 00:40:01,760
is the actual framing of the picture of

949
00:40:05,030 --> 00:40:03,680
the video that we'll be taking

950
00:40:07,190 --> 00:40:05,040
and we're making sure of course the

951
00:40:09,030 --> 00:40:07,200
engineer is in it what you probably

952
00:40:10,390 --> 00:40:09,040
can't see here is that there's a tiny

953
00:40:13,510 --> 00:40:10,400
helicopter in there

954
00:40:14,950 --> 00:40:13,520
a little graphic of it and

955
00:40:16,710 --> 00:40:14,960
what we want to make sure of is that we

956
00:40:18,309 --> 00:40:16,720
catch the flight remember how tim was

957
00:40:21,589 --> 00:40:18,319
explaining how they're going to go up

958
00:40:23,589 --> 00:40:21,599
3 feet 3 meters of course

959
00:40:25,430 --> 00:40:23,599
about 10 feet up into the air so we want

960
00:40:28,870 --> 00:40:25,440
to make sure we can catch that into

961
00:40:30,550 --> 00:40:28,880
our video but as you can see

962
00:40:32,150 --> 00:40:30,560
when you're looking from the rover it's

963
00:40:35,910 --> 00:40:32,160

going to be pretty small

964
00:40:41,109 --> 00:40:39,109
here you go now imagine

965
00:40:43,430 --> 00:40:41,119
this red frame again is what we're

966
00:40:45,270 --> 00:40:43,440
actually capturing in our video

967
00:40:47,109 --> 00:40:45,280
imagine that on your computer screen do

968
00:40:48,870 --> 00:40:47,119
you think you can see the helicopter can

969
00:40:53,190 --> 00:40:48,880
you find it there

970
00:40:55,030 --> 00:40:53,200
well we'll see on sunday check it out

971
00:40:56,870 --> 00:40:55,040
as you can see one of the other aspects

972
00:40:58,390 --> 00:40:56,880
of planning this is that

973
00:41:00,150 --> 00:40:58,400
the helicopter is not actually in the

974
00:41:03,270 --> 00:41:00,160
middle of the picture because we're

975
00:41:03,910 --> 00:41:03,280
expecting it to take flight so these are

976
00:41:05,430 --> 00:41:03,920
the other

977
00:41:07,829 --> 00:41:05,440
details that we've been working out with

978
00:41:10,950 --> 00:41:07,839
the ingenuity team

979
00:41:12,230 --> 00:41:10,960
um we had to like i was explaining we

980
00:41:13,910 --> 00:41:12,240
have to really eke out the

981
00:41:16,069 --> 00:41:13,920
the biggest performance we can from

982
00:41:17,670 --> 00:41:16,079
these cameras it's kind of like taking a

983
00:41:21,750 --> 00:41:17,680
bucket of water

984
00:41:24,309 --> 00:41:21,760
and you're trying to drink drink from it

985
00:41:25,510 --> 00:41:24,319
with a straw we have just a little bit

986
00:41:27,270 --> 00:41:25,520
of down link

987
00:41:29,190 --> 00:41:27,280
compared to the amount of data that we

988
00:41:31,670 --> 00:41:29,200

can generate even in this five minute

989
00:41:33,190 --> 00:41:31,680
video that we'll be taking

990
00:41:34,790 --> 00:41:33,200
there's no way we could get it down on

991
00:41:36,710 --> 00:41:34,800
the ground it would take us months if we

992
00:41:38,950 --> 00:41:36,720
did it at the same resolution

993
00:41:40,630 --> 00:41:38,960
and the same sharpness that we take our

994
00:41:42,470 --> 00:41:40,640
usual images that you're used to seeing

995
00:41:45,829 --> 00:41:42,480
from the mask mz cameras

996
00:41:47,990 --> 00:41:45,839
so we had to get pretty creative

997
00:41:49,510 --> 00:41:48,000
we're trying to get seven pictures a

998
00:41:51,990 --> 00:41:49,520
second that's our highest

999
00:41:54,230 --> 00:41:52,000
rate of video and that's what we'll be

1000
00:41:55,030 --> 00:41:54,240
doing on sunday so we had to subframe it

1001
00:41:56,950 --> 00:41:55,040
we had to take

1002
00:41:58,069 --> 00:41:56,960
just part of the frame about half the

1003
00:42:00,230 --> 00:41:58,079
frame

1004
00:42:02,550 --> 00:42:00,240
then we had to compress it really hard

1005
00:42:04,550 --> 00:42:02,560
oh we don't like compression we like to

1006
00:42:05,349 --> 00:42:04,560
see all the details but we have to do

1007
00:42:08,790 --> 00:42:05,359
that for this

1008
00:42:10,390 --> 00:42:08,800
otherwise it just won't work um

1009
00:42:12,470 --> 00:42:10,400
and then another thing that we have to

1010
00:42:16,630 --> 00:42:12,480
do is

1011
00:42:19,190 --> 00:42:16,640
um think about the the um

1012
00:42:21,109 --> 00:42:19,200
amount of data we can get so it would be

1013
00:42:22,230 --> 00:42:21,119

nice to get the whole entire video down

1014
00:42:23,750 --> 00:42:22,240
right away

1015
00:42:26,150 --> 00:42:23,760
but we don't have the downlink for that

1016
00:42:27,750 --> 00:42:26,160
so especially on sunday

1017
00:42:30,630 --> 00:42:27,760
or rather monday morning as we're

1018
00:42:32,309 --> 00:42:30,640
getting them really early monday morning

1019
00:42:34,630 --> 00:42:32,319
think about the fact that we had to

1020
00:42:37,670 --> 00:42:34,640
select a priori before

1021
00:42:38,710 --> 00:42:37,680
even seeing the images from mars we had

1022
00:42:41,349 --> 00:42:38,720
to select which

1023
00:42:42,710 --> 00:42:41,359
video frames to pick and choose in the

1024
00:42:44,790 --> 00:42:42,720
blind

1025
00:42:46,150 --> 00:42:44,800
so that we could get just a few of them

1026
00:42:49,190 --> 00:42:46,160
on monday morning

1027
00:42:51,109 --> 00:42:49,200
so we get to pick about six frames out

1028
00:42:52,630 --> 00:42:51,119
of a five minute span

1029
00:42:55,270 --> 00:42:52,640
they're little two and a half second

1030
00:42:57,190 --> 00:42:55,280
snippets and we did it for the first

1031
00:42:59,510 --> 00:42:57,200
time last night actually

1032
00:43:00,309 --> 00:42:59,520
and what tim showed you was one of the

1033
00:43:04,150 --> 00:43:00,319
examples

1034
00:43:05,670 --> 00:43:04,160
of from the spin test and of the six

1035
00:43:09,030 --> 00:43:05,680
frames that we guessed

1036
00:43:10,630 --> 00:43:09,040
two of them hit the jackpot so

1037
00:43:12,950 --> 00:43:10,640
that's all we can do because we have

1038
00:43:15,030 --> 00:43:12,960

about 20 seconds between our guesses

1039
00:43:16,630 --> 00:43:15,040
that's what we're doing so that can span

1040
00:43:18,309 --> 00:43:16,640
more time

1041
00:43:20,390 --> 00:43:18,319
so we were just ecstatic that we

1042
00:43:24,230 --> 00:43:20,400
actually hit the jackpot the first time

1043
00:43:27,349 --> 00:43:24,240
now on sunday like mimi and amy were

1044
00:43:29,190 --> 00:43:27,359
explaining we're going to do our very

1045
00:43:32,230 --> 00:43:29,200
best to do the same

1046
00:43:33,670 --> 00:43:32,240
predicting and hopefully you'll see a

1047
00:43:36,230 --> 00:43:33,680
few snippets

1048
00:43:37,510 --> 00:43:36,240
regardless of whether we hit the jackpot

1049
00:43:41,349 --> 00:43:37,520
that first time

1050
00:43:44,069 --> 00:43:41,359
we'll definitely get some images and um

1051
00:43:44,550 --> 00:43:44,079
we'll also over the next couple of days

1052
00:43:48,470 --> 00:43:44,560
we'll get

1053
00:43:50,150 --> 00:43:48,480
in lower resolution and then in higher

1054
00:43:52,630 --> 00:43:50,160
resolution

1055
00:43:54,150 --> 00:43:52,640
um so what i want you to imagine also is

1056
00:43:56,150 --> 00:43:54,160
that we actually have

1057
00:43:57,829 --> 00:43:56,160
two different ways of taking video at

1058
00:44:00,309 --> 00:43:57,839
the same time

1059
00:44:02,309 --> 00:44:00,319
so this image here which actually this

1060
00:44:03,430 --> 00:44:02,319
mosaic was created just last night with

1061
00:44:07,670 --> 00:44:03,440
the images that came

1062
00:44:10,870 --> 00:44:07,680
in by jim bell and rpi

1063
00:44:12,390 --> 00:44:10,880

and he made a mosaic of this is actually

1064
00:44:13,430 --> 00:44:12,400
mosaic you can't see it because it's

1065
00:44:15,030 --> 00:44:13,440
very well done

1066
00:44:16,950 --> 00:44:15,040
but this is kind of the close-up view

1067
00:44:19,190 --> 00:44:16,960
this is our highest resolution camera

1068
00:44:21,030 --> 00:44:19,200
this is the most zoomed in with the zoom

1069
00:44:24,390 --> 00:44:21,040
cameras we can do

1070
00:44:27,030 --> 00:44:24,400
and we're doing that with the left

1071
00:44:29,190 --> 00:44:27,040
camera when we're taking the video

1072
00:44:30,630 --> 00:44:29,200
and that's great you know we'll see as

1073
00:44:31,829 --> 00:44:30,640
much detail as we can with the

1074
00:44:34,950 --> 00:44:31,839
compression that i mentioned

1075
00:44:37,109 --> 00:44:34,960
so keep that in mind but

1076
00:44:38,069 --> 00:44:37,119
ingenuity will actually fly right out of

1077
00:44:41,349 --> 00:44:38,079
the frame

1078
00:44:43,270 --> 00:44:41,359
if we only took images like this

1079
00:44:44,870 --> 00:44:43,280
so with the other camera the right

1080
00:44:46,390 --> 00:44:44,880
camera if i can have the next graphic

1081
00:44:49,589 --> 00:44:46,400
please

1082
00:44:49,990 --> 00:44:49,599
so compare those two images and see that

1083
00:44:52,069 --> 00:44:50,000
then the

1084
00:44:53,030 --> 00:44:52,079
right camera would look at this we're

1085
00:44:56,550 --> 00:44:53,040
having the most

1086
00:44:58,950 --> 00:44:56,560
zoomed out view that we can um it's

1087
00:45:02,230 --> 00:44:58,960
going to be with the 34 millimeter

1088
00:45:05,589 --> 00:45:02,240

zoom level and so one is at 110

1089
00:45:07,430 --> 00:45:05,599
and one is 34 millimeters and

1090
00:45:09,430 --> 00:45:07,440
we're taking those simultaneously so

1091
00:45:10,710 --> 00:45:09,440
that with this more zoomed out view we

1092
00:45:13,510 --> 00:45:10,720
won't see as much detail

1093
00:45:14,309 --> 00:45:13,520
but we will hopefully that's our

1094
00:45:16,150 --> 00:45:14,319
prediction

1095
00:45:18,630 --> 00:45:16,160
is that we'll catch the whole flight

1096
00:45:20,470 --> 00:45:18,640
with just the one frame it would be nice

1097
00:45:23,190 --> 00:45:20,480
if we could track it

1098
00:45:24,550 --> 00:45:23,200
with the with the antenna but we're not

1099
00:45:26,150 --> 00:45:24,560
allowed to do that because there could

1100
00:45:27,030 --> 00:45:26,160
be interference between the different

1101
00:45:29,030 --> 00:45:27,040
components

1102
00:45:30,710 --> 00:45:29,040
if we did that so we're going to stay

1103
00:45:32,790 --> 00:45:30,720
completely safe

1104
00:45:34,390 --> 00:45:32,800
we are going to have a zoomed out and a

1105
00:45:35,990 --> 00:45:34,400
zoomed in view

1106
00:45:37,750 --> 00:45:36,000
and then the first downlink we're going

1107
00:45:38,870 --> 00:45:37,760
to do like i said we're going to try to

1108
00:45:42,630 --> 00:45:38,880
hit the jackpot

1109
00:45:45,270 --> 00:45:42,640
with our best estimate of how to catch

1110
00:45:47,030 --> 00:45:45,280
just a little bit of the zoomed out view

1111
00:45:49,349 --> 00:45:47,040
we thought that would be best

1112
00:45:50,950 --> 00:45:49,359
because if if it's already flying as

1113
00:45:53,190 --> 00:45:50,960

we're catching it

1114
00:45:55,349 --> 00:45:53,200
we could um have the best chance of

1115
00:45:58,470 --> 00:45:55,359
giving you some great video on sunday

1116
00:46:02,230 --> 00:45:58,480
monday morning all right

1117
00:46:03,670 --> 00:46:02,240
so um just want to set expectations this

1118
00:46:06,710 --> 00:46:03,680
is really hard

1119
00:46:09,670 --> 00:46:06,720
we have practiced it like tim explained

1120
00:46:11,030 --> 00:46:09,680
um between the heli team and the mask mz

1121
00:46:13,190 --> 00:46:11,040
team and the rover team

1122
00:46:14,870 --> 00:46:13,200
we've been um doing really well on these

1123
00:46:17,990 --> 00:46:14,880
tests this week actually

1124
00:46:19,190 --> 00:46:18,000
so we hope everything will go well on

1125
00:46:22,550 --> 00:46:19,200
sunday

1126
00:46:24,710 --> 00:46:22,560
but we know there'll be surprises

1127
00:46:25,589 --> 00:46:24,720
that's what we train for that's what we

1128
00:46:27,750 --> 00:46:25,599
test for

1129
00:46:29,190 --> 00:46:27,760
there will be surprises and you will be

1130
00:46:32,630 --> 00:46:29,200
learning about them

1131
00:46:36,150 --> 00:46:32,640
right at the same time that we will so

1132
00:46:38,630 --> 00:46:36,160
let's all get the popcorn

1133
00:46:39,910 --> 00:46:38,640
sit in front of our seats on sunday

1134
00:46:43,109 --> 00:46:39,920
monday morning

1135
00:46:44,390 --> 00:46:43,119
and let's see ingenuity tech flight i'm

1136
00:46:46,710 --> 00:46:44,400
so excited

1137
00:46:49,190 --> 00:46:46,720
we're just delighted to be here with you

1138
00:46:50,870 --> 00:46:49,200

thank you for having us come along

1139
00:46:54,069 --> 00:46:50,880
we're going to be there supporting you

1140
00:46:57,430 --> 00:46:54,079
from the rover big sisters watching

1141
00:47:00,470 --> 00:46:57,440
and uh let's go flight

1142
00:47:02,870 --> 00:47:00,480
back to you raquel thank you elsa and

1143
00:47:04,870 --> 00:47:02,880
thank you to our panelists we are now

1144
00:47:06,950 --> 00:47:04,880
ready to take media questions

1145
00:47:09,030 --> 00:47:06,960
remember to press star one to get put in

1146
00:47:11,030 --> 00:47:09,040
the queue and please direct your

1147
00:47:12,950 --> 00:47:11,040
questions to one of the panelists

1148
00:47:14,950 --> 00:47:12,960
and we're also taking questions through

1149
00:47:18,230 --> 00:47:14,960
the mars helicopter

1150
00:47:23,030 --> 00:47:18,240
hashtag up first on the phone lines is

1151
00:47:27,829 --> 00:47:24,790
hey guys thanks for taking my question

1152
00:47:30,069 --> 00:47:27,839
can you hear me yes we can

1153
00:47:31,910 --> 00:47:30,079
great uh i wonder if someone there maybe

1154
00:47:33,589 --> 00:47:31,920
uh mimi or tim can just talk about the

1155
00:47:35,030 --> 00:47:33,599
rotor blades specifically and how

1156
00:47:37,589 --> 00:47:35,040
they're able to generate

1157
00:47:39,109 --> 00:47:37,599
uh lift in that thin martian atmosphere

1158
00:47:42,230 --> 00:47:39,119
i'm curious how long

1159
00:47:44,470 --> 00:47:42,240
each of the four blades are and also how

1160
00:47:47,190 --> 00:47:44,480
does the counter rotation work

1161
00:47:48,150 --> 00:47:47,200
to uh allow lift and then just generally

1162
00:47:50,150 --> 00:47:48,160
how big of a

1163
00:47:51,589 --> 00:47:50,160

challenge is it to fly a vehicle given

1164
00:47:54,630 --> 00:47:51,599
the thin martian atmosphere

1165
00:47:54,950 --> 00:47:54,640
thanks so much sure i can take the first

1166
00:47:58,549 --> 00:47:54,960
cut

1167
00:48:00,150 --> 00:47:58,559
at this so yeah the blades are 1.2 meter

1168
00:48:02,390 --> 00:48:00,160
tip to tip

1169
00:48:03,510 --> 00:48:02,400
and they are two pairs right counter

1170
00:48:06,790 --> 00:48:03,520
rotating

1171
00:48:08,630 --> 00:48:06,800
and the blade itself the shape

1172
00:48:10,069 --> 00:48:08,640
the the blade distribution the core

1173
00:48:12,230 --> 00:48:10,079
distribution the twist

1174
00:48:13,670 --> 00:48:12,240
is carefully modeled so the cross

1175
00:48:16,230 --> 00:48:13,680
section is the airfoil

1176
00:48:18,230 --> 00:48:16,240
that was uh adopted uh from aero

1177
00:48:19,670 --> 00:48:18,240
varmints a high altitude aircraft

1178
00:48:22,549 --> 00:48:19,680
vehicle there on our team

1179
00:48:24,150 --> 00:48:22,559
we took that cross cut airfoil and then

1180
00:48:25,430 --> 00:48:24,160
it was optimized in terms of how the

1181
00:48:28,630 --> 00:48:25,440
blade would be shaped

1182
00:48:31,910 --> 00:48:28,640
by cfd analysis and simulations at

1183
00:48:34,630 --> 00:48:31,920
ames and langley and then that blade

1184
00:48:36,230 --> 00:48:34,640
was analyzed actually in about 32

1185
00:48:38,390 --> 00:48:36,240
analytical slices

1186
00:48:39,750 --> 00:48:38,400
and the lift and the drag was modeled

1187
00:48:42,230 --> 00:48:39,760
for each of those pieces

1188
00:48:43,589 --> 00:48:42,240

and integrated and then simulated how

1189
00:48:45,589 --> 00:48:43,599
the vehicle would react

1190
00:48:47,510 --> 00:48:45,599
when you spin such a blade you know and

1191
00:48:49,750 --> 00:48:47,520
we so it was really optimized

1192
00:48:51,510 --> 00:48:49,760
taking from that dynamic prediction of

1193
00:48:52,309 --> 00:48:51,520
how the vehicle would react when you

1194
00:48:55,430 --> 00:48:52,319
spin

1195
00:48:57,589 --> 00:48:55,440
then hovard grips the jpl team

1196
00:48:59,270 --> 00:48:57,599
came back and then design a closed-loop

1197
00:49:01,750 --> 00:48:59,280
control system around it

1198
00:49:03,589 --> 00:49:01,760
to make sure that we sample fast enough

1199
00:49:06,230 --> 00:49:03,599
and send the controls back to

1200
00:49:07,829 --> 00:49:06,240
control the blade uh pitch fast enough

1201
00:49:09,109 --> 00:49:07,839
like it turns out it takes hundreds

1202
00:49:11,510 --> 00:49:09,119
about four or five hundred

1203
00:49:12,390 --> 00:49:11,520
times per second to design the closed

1204
00:49:16,069 --> 00:49:12,400
loop control

1205
00:49:18,790 --> 00:49:16,079
so yes absolutely those blades are not

1206
00:49:19,829 --> 00:49:18,800
something off the shelf really fine well

1207
00:49:22,069 --> 00:49:19,839
fine tune

1208
00:49:24,390 --> 00:49:22,079
to maximize the lift that we can

1209
00:49:25,910 --> 00:49:24,400
generate in such a thin atmosphere

1210
00:49:27,750 --> 00:49:25,920
and one of the things that we did learn

1211
00:49:29,030 --> 00:49:27,760
right off the bat as you saw in the

1212
00:49:32,150 --> 00:49:29,040
video that amy showed

1213
00:49:34,630 --> 00:49:32,160

what's the dynamics of spinning a blade

1214
00:49:36,309 --> 00:49:34,640
in this thin atmosphere of mars this

1215
00:49:38,630 --> 00:49:36,319
reynolds numbers and mach number

1216
00:49:40,549 --> 00:49:38,640
pair right very specific to mars the

1217
00:49:43,750 --> 00:49:40,559
reaction is very different from what we

1218
00:49:46,870 --> 00:49:45,829
great thank you and up next we have

1219
00:49:49,910 --> 00:49:46,880
marina corrin

1220
00:49:51,990 --> 00:49:49,920
from the atlantic

1221
00:49:52,950 --> 00:49:52,000
hi everybody um this is a question i

1222
00:49:55,910 --> 00:49:52,960
think for mimi

1223
00:49:57,510 --> 00:49:55,920
or tim um so once you've reached the end

1224
00:49:59,349 --> 00:49:57,520
of your month of operations and

1225
00:50:01,910 --> 00:49:59,359
perseverance drives away

1226
00:50:03,349 --> 00:50:01,920
what happens to ingenuity and by that i

1227
00:50:05,030 --> 00:50:03,359
mean will it technically

1228
00:50:06,390 --> 00:50:05,040
be functional because it can still

1229
00:50:08,309 --> 00:50:06,400
charge itself

1230
00:50:10,470 --> 00:50:08,319
how long can it remain technically alive

1231
00:50:12,790 --> 00:50:10,480
on the surface and has anyone considered

1232
00:50:14,870 --> 00:50:12,800
having percy return to visit ingenuity

1233
00:50:18,309 --> 00:50:14,880
someday

1234
00:50:21,030 --> 00:50:18,319
oh i'll take this step ingenuity

1235
00:50:22,630 --> 00:50:21,040
is a solar-powered vehicle so therefore

1236
00:50:23,430 --> 00:50:22,640
there are no consumables that can run

1237
00:50:26,230 --> 00:50:23,440
out so to speak

1238
00:50:28,069 --> 00:50:26,240

so that that's one fact but ingenuity is

1239
00:50:30,790 --> 00:50:28,079
also it doesn't have a self-writing

1240
00:50:32,390 --> 00:50:30,800
system so if we do have a bad landing uh

1241
00:50:35,349 --> 00:50:32,400
that would be the end of mission

1242
00:50:37,270 --> 00:50:35,359
so uh our estimate is that the lifetime

1243
00:50:37,990 --> 00:50:37,280
will be determined by how well it lands

1244
00:50:41,349 --> 00:50:38,000
pretty much

1245
00:50:43,510 --> 00:50:41,359
so we have 30 valuable days uh to

1246
00:50:44,549 --> 00:50:43,520
do this experiment at mars and we are

1247
00:50:46,710 --> 00:50:44,559
going to be

1248
00:50:48,069 --> 00:50:46,720
as tim described uh taking a very

1249
00:50:50,150 --> 00:50:48,079
conservative flight to

1250
00:50:51,670 --> 00:50:50,160
really nail the first flight and after

1251
00:50:52,710 --> 00:50:51,680
that we'll be taking boulder and boulder

1252
00:50:55,750 --> 00:50:52,720
flights we'll be going

1253
00:50:57,990 --> 00:50:55,760
higher further and in fact

1254
00:50:59,990 --> 00:50:58,000
by by the fifth flight if we get there

1255
00:51:00,950 --> 00:51:00,000
that far uh we are going to take very

1256
00:51:03,990 --> 00:51:00,960
bold flights

1257
00:51:04,870 --> 00:51:04,000
and uh take high risk and probabilities

1258
00:51:06,950 --> 00:51:04,880
are we

1259
00:51:08,069 --> 00:51:06,960
uh it would be unlikely to land safely

1260
00:51:09,510 --> 00:51:08,079
because we'll start going into

1261
00:51:12,870 --> 00:51:09,520
unsurveyed areas

1262
00:51:14,950 --> 00:51:12,880
um and and after that after 30 days

1263
00:51:16,630 --> 00:51:14,960

even if ingenuity is surviving you know

1264
00:51:18,230 --> 00:51:16,640
this increasing risk that we do plan to

1265
00:51:19,750 --> 00:51:18,240
take because we want to stretch

1266
00:51:21,990 --> 00:51:19,760
and understand the capability of this

1267
00:51:24,630 --> 00:51:22,000
little vehicle even if it survived

1268
00:51:25,510 --> 00:51:24,640
is we are going to turn back the key uh

1269
00:51:28,230 --> 00:51:25,520
back to uh

1270
00:51:29,990 --> 00:51:28,240
the rover team uh ken farley our project

1271
00:51:30,790 --> 00:51:30,000
scientist for perspirance has been so

1272
00:51:33,589 --> 00:51:30,800
generous

1273
00:51:34,630 --> 00:51:33,599
it gave us 30 invaluable days on mars

1274
00:51:36,870 --> 00:51:34,640
and we will um

1275
00:51:38,470 --> 00:51:36,880
you know engineered perseverance really

1276
00:51:39,349 --> 00:51:38,480
must go on to the primary mission that

1277
00:51:41,510 --> 00:51:39,359
they are on

1278
00:51:43,990 --> 00:51:41,520
so that's the plan thomas would you also

1279
00:51:47,030 --> 00:51:44,000
like to answer the question

1280
00:51:49,030 --> 00:51:47,040
i just wanted to add kind of uh the

1281
00:51:51,190 --> 00:51:49,040
the view on this that and very much in

1282
00:51:53,750 --> 00:51:51,200
support of what mimi just said uh

1283
00:51:56,790 --> 00:51:53,760
i just want to go back to sojourner and

1284
00:51:58,950 --> 00:51:56,800
remind everybody that uh sojourner also

1285
00:52:00,710 --> 00:51:58,960
was a tech demonstration a tech

1286
00:52:02,630 --> 00:52:00,720
demonstration by the way without which

1287
00:52:06,390 --> 00:52:02,640
we could not imagine perseverance

1288
00:52:09,030 --> 00:52:06,400

we could not imagine more sample return

1289
00:52:09,510 --> 00:52:09,040
which was really uh pioneered with this

1290
00:52:11,750 --> 00:52:09,520
and

1291
00:52:14,069 --> 00:52:11,760
for me uh you know what zoe turner did

1292
00:52:16,309 --> 00:52:14,079
did exactly what mimi just said which is

1293
00:52:18,470 --> 00:52:16,319
if you want aggressively punch out the

1294
00:52:21,589 --> 00:52:18,480
space in which it can operate

1295
00:52:24,150 --> 00:52:21,599
taking risks excessively larger risks

1296
00:52:24,710 --> 00:52:24,160
and the month of ingenuity will really

1297
00:52:27,270 --> 00:52:24,720
be

1298
00:52:28,150 --> 00:52:27,280
a demonstration of the capability that

1299
00:52:31,109 --> 00:52:28,160
is there

1300
00:52:32,309 --> 00:52:31,119
and leading to uh to the very success i

1301
00:52:35,190 --> 00:52:32,319
think in the long run

1302
00:52:37,589 --> 00:52:35,200
that soacherner has a success that at

1303
00:52:40,069 --> 00:52:37,599
the time of sojourner of course was not

1304
00:52:42,069 --> 00:52:40,079
imagined that we could be sitting here

1305
00:52:42,950 --> 00:52:42,079
with perseverance there on mars sample

1306
00:52:44,710 --> 00:52:42,960
return

1307
00:52:46,710 --> 00:52:44,720
can you only imagine what will happen

1308
00:52:49,109 --> 00:52:46,720
after this month of ingenuity

1309
00:52:51,030 --> 00:52:49,119
just two decades from now or one decade

1310
00:52:52,950 --> 00:52:51,040
from now

1311
00:52:56,790 --> 00:52:52,960
thank you for your answers up next is

1312
00:52:58,390 --> 00:52:56,800
elizabeth howell from space.com

1313
00:53:00,309 --> 00:52:58,400

hi everyone i think this question is

1314
00:53:01,750 --> 00:53:00,319
from mimi if and when you get those

1315
00:53:03,589 --> 00:53:01,760
first views from ingenuity and

1316
00:53:05,190 --> 00:53:03,599
perseverance of the flight what kind of

1317
00:53:07,510 --> 00:53:05,200
feelings will it evoke in you

1318
00:53:09,430 --> 00:53:07,520
and also are you planning to use percy's

1319
00:53:11,270 --> 00:53:09,440
microphones to record audio of the

1320
00:53:13,670 --> 00:53:11,280
flight

1321
00:53:15,430 --> 00:53:13,680
right i'll give the first part and i am

1322
00:53:19,270 --> 00:53:15,440
going to have tim cannon also

1323
00:53:21,430 --> 00:53:19,280
jump in so that the image is uh

1324
00:53:22,710 --> 00:53:21,440
uh it will be inspiring it's really hard

1325
00:53:24,470 --> 00:53:22,720
to imagine uh

1326
00:53:25,829 --> 00:53:24,480
you know how i'm gonna feel because our

1327
00:53:28,790 --> 00:53:25,839
team to be frank has

1328
00:53:30,309 --> 00:53:28,800
never let ourselves celebrate fully

1329
00:53:31,910 --> 00:53:30,319
because we've been waiting for really

1330
00:53:34,549 --> 00:53:31,920
this first flight on mars so

1331
00:53:35,750 --> 00:53:34,559
i believe i'll be really excited to see

1332
00:53:37,349 --> 00:53:35,760
first and foremost

1333
00:53:39,270 --> 00:53:37,359
probably i'll be more excited about the

1334
00:53:42,150 --> 00:53:39,280
black and white camera image

1335
00:53:43,910 --> 00:53:42,160
because to me and a lot of majority of

1336
00:53:45,670 --> 00:53:43,920
the team you know most all of the team

1337
00:53:47,190 --> 00:53:45,680
it's about this engineering technology

1338
00:53:49,670 --> 00:53:47,200

demonstration and

1339
00:53:51,270 --> 00:53:49,680
getting back that engineering data on

1340
00:53:54,309 --> 00:53:51,280
how well did it fly

1341
00:53:56,470 --> 00:53:54,319
because to me it is about the future

1342
00:53:58,870 --> 00:53:56,480
it is about adding that arrow dimension

1343
00:53:59,270 --> 00:53:58,880
and do we model right is our analysis

1344
00:54:01,349 --> 00:53:59,280
right

1345
00:54:03,270 --> 00:54:01,359
and more importantly did we overlook

1346
00:54:05,109 --> 00:54:03,280
anything and what do we learn how

1347
00:54:07,270 --> 00:54:05,119
differently did it fly over there

1348
00:54:08,790 --> 00:54:07,280
so for me the black and white picture is

1349
00:54:11,190 --> 00:54:08,800
going to be invaluable coupled with the

1350
00:54:13,190 --> 00:54:11,200
imu daters altimeter data

1351
00:54:14,870 --> 00:54:13,200
and the inclinometer data all combined

1352
00:54:17,190 --> 00:54:14,880
and how do we fly

1353
00:54:18,790 --> 00:54:17,200
and the color picture is going to be

1354
00:54:20,549 --> 00:54:18,800
icing on the cake

1355
00:54:22,069 --> 00:54:20,559
so tim you want to chime in a little bit

1356
00:54:24,950 --> 00:54:22,079
about how you're going to feel about

1357
00:54:27,430 --> 00:54:24,960
seeing those camera images

1358
00:54:28,309 --> 00:54:27,440
yeah well naturally the team's working

1359
00:54:30,230 --> 00:54:28,319
really hard

1360
00:54:31,829 --> 00:54:30,240
to be ready for this moment and so when

1361
00:54:33,829 --> 00:54:31,839
we see that the data from that first

1362
00:54:35,910 --> 00:54:33,839
flight and it works it'll be

1363
00:54:37,430 --> 00:54:35,920

an incredible moment the culmination of

1364
00:54:38,549 --> 00:54:37,440
all this work and all the hopes that

1365
00:54:40,870 --> 00:54:38,559
we've put into it

1366
00:54:41,670 --> 00:54:40,880
and yes mimi is right the primary

1367
00:54:43,829 --> 00:54:41,680
purpose of this

1368
00:54:45,430 --> 00:54:43,839
project is to get that detailed

1369
00:54:46,950 --> 00:54:45,440
engineering data that we can see the

1370
00:54:48,950 --> 00:54:46,960
performance of the vehicle

1371
00:54:50,950 --> 00:54:48,960
and then that data can be used by future

1372
00:54:52,150 --> 00:54:50,960
projects to make even bigger and better

1373
00:54:54,390 --> 00:54:52,160
helicopters

1374
00:54:56,309 --> 00:54:54,400
but at the same time getting a color

1375
00:54:57,750 --> 00:54:56,319
image while in flight will be exciting

1376
00:54:59,589 --> 00:54:57,760
from from an outreach point of view

1377
00:55:01,750 --> 00:54:59,599
people get to get that aerial view of

1378
00:55:04,549 --> 00:55:01,760
what the helicopter is seeing

1379
00:55:05,990 --> 00:55:04,559
and it'll be amazing you've seen that

1380
00:55:07,030 --> 00:55:06,000
picture that we've had out can you

1381
00:55:09,349 --> 00:55:07,040
imagine that picture

1382
00:55:10,710 --> 00:55:09,359
being that nice 13 megapixel picture

1383
00:55:11,349 --> 00:55:10,720
we're seeing the dirt right now in

1384
00:55:13,190 --> 00:55:11,359
essence

1385
00:55:14,549 --> 00:55:13,200
but as we go along to three meters and

1386
00:55:16,710 --> 00:55:14,559
then eventually to five meters getting

1387
00:55:19,109 --> 00:55:16,720
that panoramic view of mars from

1388
00:55:20,870 --> 00:55:19,119

15 meters up will be amazing and there

1389
00:55:22,470 --> 00:55:20,880
was a question about the microphone

1390
00:55:24,309 --> 00:55:22,480
super cam the instrument has a

1391
00:55:25,670 --> 00:55:24,319
microphone and

1392
00:55:27,270 --> 00:55:25,680
we're not going to do it on the first

1393
00:55:28,950 --> 00:55:27,280
flight but we're in discussions about

1394
00:55:29,990 --> 00:55:28,960
subsequent flights maybe using that

1395
00:55:32,230 --> 00:55:30,000
camera

1396
00:55:34,630 --> 00:55:32,240
microphone to point where near where the

1397
00:55:36,390 --> 00:55:34,640
helicopter is and try and get some audio

1398
00:55:37,589 --> 00:55:36,400
it's very touch and go as to whether we

1399
00:55:38,710 --> 00:55:37,599
would even hear anything at that

1400
00:55:41,190 --> 00:55:38,720
distance

1401
00:55:42,630 --> 00:55:41,200
but uh as i said discussions are ongoing

1402
00:55:44,470 --> 00:55:42,640
we might give it a try

1403
00:55:46,069 --> 00:55:44,480
worst comes to worse we'll get a lot of

1404
00:55:49,510 --> 00:55:46,079
nothing but who knows maybe we'll catch

1405
00:55:51,990 --> 00:55:49,520
the sound of the helicopter lifting off

1406
00:55:53,990 --> 00:55:52,000
great thanks tim and thank you mimi up

1407
00:55:57,349 --> 00:55:54,000
next is paul brinkman with

1408
00:56:00,549 --> 00:55:57,359
upi yeah hi

1409
00:56:02,390 --> 00:56:00,559
thanks um just a little bit more about

1410
00:56:04,150 --> 00:56:02,400
the images

1411
00:56:05,670 --> 00:56:04,160
so i guess this question is for elsa

1412
00:56:07,670 --> 00:56:05,680
jensen but um

1413
00:56:08,870 --> 00:56:07,680

how does the uh how does the helicopter

1414
00:56:11,670 --> 00:56:08,880
and the rover transmit

1415
00:56:12,950 --> 00:56:11,680
images um do they they communicate with

1416
00:56:15,990 --> 00:56:12,960
each other back and forth

1417
00:56:18,470 --> 00:56:16,000
and what is that link like and then um

1418
00:56:20,069 --> 00:56:18,480
do we do i understand correctly that at

1419
00:56:21,430 --> 00:56:20,079
the early morning

1420
00:56:22,950 --> 00:56:21,440
press conferences we're only going to

1421
00:56:25,190 --> 00:56:22,960
have black and white images is that

1422
00:56:27,510 --> 00:56:25,200
correct

1423
00:56:28,950 --> 00:56:27,520
great questions there's actually two

1424
00:56:30,549 --> 00:56:28,960
parts to what you're asking

1425
00:56:32,710 --> 00:56:30,559
so the part that we're doing from the

1426
00:56:35,190 --> 00:56:32,720
masscam z side you know again

1427
00:56:36,950 --> 00:56:35,200
perched up at the top of the rover we're

1428
00:56:37,750 --> 00:56:36,960
going to be looking with our mass cam z

1429
00:56:39,109 --> 00:56:37,760
cameras

1430
00:56:40,789 --> 00:56:39,119
there in color we're going to use the

1431
00:56:44,069 --> 00:56:40,799
color filters rgb

1432
00:56:47,109 --> 00:56:44,079
for that so all of our images and

1433
00:56:49,589 --> 00:56:47,119
our video will be in color now

1434
00:56:50,549 --> 00:56:49,599
that imagery will be sent from the rover

1435
00:56:53,190 --> 00:56:50,559
to the orbiter

1436
00:56:54,549 --> 00:56:53,200
back to earth so there's that whole path

1437
00:56:56,549 --> 00:56:54,559
and then the other part of what you're

1438
00:56:58,870 --> 00:56:56,559

asking i'll pass on to tim because that

1439
00:57:01,510 --> 00:56:58,880
has to do with the images coming from

1440
00:57:03,109 --> 00:57:01,520
ingenuity and the helicopter team is

1441
00:57:06,309 --> 00:57:03,119
taking those images so

1442
00:57:08,789 --> 00:57:06,319
tim do you want to address that part

1443
00:57:10,230 --> 00:57:08,799
sure and we in many ways we follow a

1444
00:57:13,190 --> 00:57:10,240
similar similar path

1445
00:57:13,910 --> 00:57:13,200
as the mass cam z the helicopter does

1446
00:57:16,230 --> 00:57:13,920
its flights

1447
00:57:17,510 --> 00:57:16,240
and it's taking this detailed data

1448
00:57:19,349 --> 00:57:17,520
during the flight

1449
00:57:21,750 --> 00:57:19,359
and then we land but right after the

1450
00:57:23,670 --> 00:57:21,760
flight we're gonna we have used up a lot

1451
00:57:24,069 --> 00:57:23,680
of our battery energy so we don't have a

1452
00:57:26,150 --> 00:57:24,079
lot of

1453
00:57:28,150 --> 00:57:26,160
excess energy to spend time transmitting

1454
00:57:31,430 --> 00:57:28,160
the data back to the rover

1455
00:57:32,870 --> 00:57:31,440
and so on that first transmission day

1456
00:57:34,230 --> 00:57:32,880
the first downlink day we're going to

1457
00:57:35,990 --> 00:57:34,240
concentrate on getting back that

1458
00:57:38,230 --> 00:57:36,000
detailed engineering data so that the

1459
00:57:39,829 --> 00:57:38,240
team can analyze what happened

1460
00:57:42,230 --> 00:57:39,839
and part of that engineering data is

1461
00:57:44,870 --> 00:57:42,240
that black and white downward pointing

1462
00:57:46,950 --> 00:57:44,880
uh camera because that's used by the

1463
00:57:49,030 --> 00:57:46,960

team to relocalize the helicopter to

1464
00:57:51,349 --> 00:57:49,040
figure out exactly where it landed

1465
00:57:52,150 --> 00:57:51,359
but the data follows a very similar path

1466
00:57:54,309 --> 00:57:52,160
in that

1467
00:57:56,390 --> 00:57:54,319
the helicopter has a radio link back to

1468
00:57:58,150 --> 00:57:56,400
the rover we have our

1469
00:57:59,829 --> 00:57:58,160
helicopter base station on the rover

1470
00:58:01,910 --> 00:57:59,839
which has its own storage

1471
00:58:03,910 --> 00:58:01,920
and then that storage gets copied back

1472
00:58:05,670 --> 00:58:03,920
to the rover and then sent down to earth

1473
00:58:07,670 --> 00:58:05,680
so on that first saw we're going to

1474
00:58:09,109 --> 00:58:07,680
transmit those

1475
00:58:10,789 --> 00:58:09,119
those black and white images we're going

1476
00:58:12,470 --> 00:58:10,799
to get summary data of the flight we

1477
00:58:12,950 --> 00:58:12,480
don't have again the time to transmit on

1478
00:58:15,829 --> 00:58:12,960
the radio

1479
00:58:17,109 --> 00:58:15,839
the very detailed logs of the flight and

1480
00:58:19,190 --> 00:58:17,119
then we're going to let the helicopter

1481
00:58:21,670 --> 00:58:19,200
go to sleep and recharge its batteries

1482
00:58:23,270 --> 00:58:21,680
on the following saw that's when we're

1483
00:58:24,870 --> 00:58:23,280
going to wake the helicopter back up and

1484
00:58:26,870 --> 00:58:24,880
we're going to transmit

1485
00:58:28,309 --> 00:58:26,880
that color image back to the rover for

1486
00:58:29,589 --> 00:58:28,319
downlink to earth so that's the first

1487
00:58:31,270 --> 00:58:29,599
time we'll see it

1488
00:58:33,430 --> 00:58:31,280

and then in subsequent solves we'll be

1489
00:58:35,430 --> 00:58:33,440
transferring more and more of that

1490
00:58:37,589 --> 00:58:35,440
very detailed engineering data that's

1491
00:58:39,910 --> 00:58:37,599
kind of the prize of this project

1492
00:58:40,630 --> 00:58:39,920
and doing even deeper analysis on that

1493
00:58:43,510 --> 00:58:40,640
so

1494
00:58:44,150 --> 00:58:43,520
the helicopter and the mass cam z don't

1495
00:58:46,230 --> 00:58:44,160
talk

1496
00:58:47,910 --> 00:58:46,240
in the sense that the two the two

1497
00:58:48,710 --> 00:58:47,920
devices on the rover don't talk but of

1498
00:58:50,150 --> 00:58:48,720
course

1499
00:58:51,990 --> 00:58:50,160
elsa and our team have been talking a

1500
00:58:52,870 --> 00:58:52,000
lot about how to synchronize our timing

1501
00:58:55,190 --> 00:58:52,880
to make sure that

1502
00:58:56,390 --> 00:58:55,200
that the mass cam z gets the images at

1503
00:58:58,309 --> 00:58:56,400
the right time so there's human

1504
00:59:00,069 --> 00:58:58,319
synchronization but not necessarily

1505
00:59:01,910 --> 00:59:00,079
rover to heli synchronization and else

1506
00:59:03,190 --> 00:59:01,920
and our team have been very excited

1507
00:59:06,309 --> 00:59:03,200
and we've been very excited at the great

1508
00:59:08,789 --> 00:59:06,319
images we've seen from them

1509
00:59:12,069 --> 00:59:08,799
up next we have andrea linfelder from

1510
00:59:15,829 --> 00:59:15,030
hi uh thank you this question for mimi i

1511
00:59:17,750 --> 00:59:15,839
was hoping

1512
00:59:19,349 --> 00:59:17,760
you know you could help us understand a

1513
00:59:21,670 --> 00:59:19,359

little more just

1514
00:59:23,349 --> 00:59:21,680
why it's hard to fly in the thin martian

1515
00:59:25,510 --> 00:59:23,359
atmosphere like i get that it has to be

1516
00:59:26,069 --> 00:59:25,520
lighter and faster but why exactly what

1517
00:59:29,589 --> 00:59:26,079
is it

1518
00:59:32,789 --> 00:59:29,599
that makes it difficult yes so

1519
00:59:33,829 --> 00:59:32,799
a rotorcraft you know flies by you know

1520
00:59:36,950 --> 00:59:33,839
generating lift

1521
00:59:39,750 --> 00:59:36,960
right and by on earth is by pushing air

1522
00:59:40,950 --> 00:59:39,760
so the blades push the air and the lift

1523
00:59:44,069 --> 00:59:40,960
is generated

1524
00:59:45,990 --> 00:59:44,079
so on mars where the atmospheric density

1525
00:59:46,549 --> 00:59:46,000
is so thin about one percent compared to

1526
00:59:49,589 --> 00:59:46,559
here

1527
00:59:52,309 --> 00:59:49,599
push

1528
00:59:53,349 --> 00:59:52,319
right and so that means that we have to

1529
00:59:56,230 --> 00:59:53,359
compensate

1530
00:59:57,109 --> 00:59:56,240
uh for flying a vehicle we have to spin

1531
00:59:59,750 --> 00:59:57,119
so much

1532
01:00:00,390 --> 00:59:59,760
faster uh than we do so if you take a

1533
01:00:02,789 --> 01:00:00,400
four pound

1534
01:00:03,430 --> 01:00:02,799
uh vehicle on earth you don't have to

1535
01:00:06,789 --> 01:00:03,440
spin it

1536
01:00:07,589 --> 01:00:06,799
you know 2400 2500 rpm that we have to

1537
01:00:10,390 --> 01:00:07,599
spin

1538
01:00:11,589 --> 01:00:10,400

on mars to generate the lift so that's

1539
01:00:12,710 --> 01:00:11,599
the first and foremost just

1540
01:00:15,430 --> 01:00:12,720
aerodynamically

1541
01:00:15,990 --> 01:00:15,440
it is extremely difficult to generate

1542
01:00:18,230 --> 01:00:16,000
lift

1543
01:00:19,510 --> 01:00:18,240
when there isn't enough um you know

1544
01:00:22,549 --> 01:00:19,520
atmospheric elements

1545
01:00:24,950 --> 01:00:22,559
uh to generate lift from so so in fact

1546
01:00:25,750 --> 01:00:24,960
that's why a helicopter has never hasn't

1547
01:00:28,390 --> 01:00:25,760
been developed

1548
01:00:30,309 --> 01:00:28,400
to fly on mars up to now because for a

1549
01:00:31,430 --> 01:00:30,319
vehicle of this kind of capability right

1550
01:00:34,710 --> 01:00:31,440
being able to

1551
01:00:36,230 --> 01:00:34,720
generate lift to lift a 1.8 kilogram

1552
01:00:37,190 --> 01:00:36,240
right four pounds on earth kind of

1553
01:00:38,870 --> 01:00:37,200
vehicle

1554
01:00:40,230 --> 01:00:38,880
and in the meantime to be able to

1555
01:00:41,589 --> 01:00:40,240
control it hundreds of

1556
01:00:43,829 --> 01:00:41,599
control the blades hundreds of times per

1557
01:00:45,349 --> 01:00:43,839
second measuring with the sensors

1558
01:00:47,670 --> 01:00:45,359
and calculating the algorithm of the

1559
01:00:48,950 --> 01:00:47,680
computers and surviving on its own being

1560
01:00:51,270 --> 01:00:48,960
able to communicate like

1561
01:00:52,150 --> 01:00:51,280
tim was describing you know all of that

1562
01:00:53,990 --> 01:00:52,160
energy you know

1563
01:00:55,430 --> 01:00:54,000

solar panels all of it together to be

1564
01:00:58,069 --> 01:00:55,440
that light

1565
01:01:01,430 --> 01:00:58,079
we just couldn't do it 15 20 years ago

1566
01:01:04,150 --> 01:01:01,440
for for a 1.8 kilogram limit so

1567
01:01:04,470 --> 01:01:04,160
thanks mimi up next we have irene klotz

1568
01:01:08,309 --> 01:01:04,480
with

1569
01:01:09,030 --> 01:01:08,319
aviation week good morning um or

1570
01:01:12,470 --> 01:01:09,040
afternoon

1571
01:01:15,430 --> 01:01:12,480
the um i have a question from mimi

1572
01:01:15,750 --> 01:01:15,440
um overall what do you think the chances

1573
01:01:17,829 --> 01:01:15,760
are

1574
01:01:19,990 --> 01:01:17,839
of a successful flight and what do you

1575
01:01:23,109 --> 01:01:20,000
think is the riskiest part

1576
01:01:26,230 --> 01:01:23,119
of the demo sure

1577
01:01:26,950 --> 01:01:26,240
um this is definitely a high risk high

1578
01:01:29,109 --> 01:01:26,960
reward

1579
01:01:31,190 --> 01:01:29,119
as uh thomas mentioned in the beginning

1580
01:01:34,390 --> 01:01:31,200
uh uh experiment so

1581
01:01:36,390 --> 01:01:34,400
um probabilities are much higher now

1582
01:01:38,710 --> 01:01:36,400
i think the whole question has been we

1583
01:01:41,109 --> 01:01:38,720
knew at launch that it is possible for

1584
01:01:41,990 --> 01:01:41,119
ingenuity to fly in the atmospheric

1585
01:01:43,829 --> 01:01:42,000
condition

1586
01:01:45,510 --> 01:01:43,839
and the terrain that is going to observe

1587
01:01:48,390 --> 01:01:45,520
in the environment from

1588
01:01:50,150 --> 01:01:48,400

all our mathematical analytical modeling

1589
01:01:50,789 --> 01:01:50,160
and testing in the chamber that amy

1590
01:01:52,549 --> 01:01:50,799
described

1591
01:01:54,069 --> 01:01:52,559
okay so the confidence is high there

1592
01:01:56,069 --> 01:01:54,079
because we've done it in

1593
01:01:57,190 --> 01:01:56,079
simulated environment on our mars as

1594
01:01:59,589 --> 01:01:57,200
much as we can

1595
01:02:00,789 --> 01:01:59,599
between now then and now has been

1596
01:02:03,109 --> 01:02:00,799
checking back off

1597
01:02:04,630 --> 01:02:03,119
you know the way we did build ingenuity

1598
01:02:07,430 --> 01:02:04,640
the parts we selected

1599
01:02:08,230 --> 01:02:07,440
and the assumptions we made how good

1600
01:02:10,470 --> 01:02:08,240
were they

1601
01:02:12,309 --> 01:02:10,480
and so far and i keep knocking on wood

1602
01:02:13,829 --> 01:02:12,319
because we had to get there first

1603
01:02:16,309 --> 01:02:13,839
they've been great you know it turned on

1604
01:02:17,430 --> 01:02:16,319
well in vacuum space vacuum to me

1605
01:02:19,270 --> 01:02:17,440
you know we were still holding the bread

1606
01:02:20,309 --> 01:02:19,280
does it work in vacuum it worked great

1607
01:02:22,549 --> 01:02:20,319
after landing

1608
01:02:24,710 --> 01:02:22,559
great did it deploy and did it survive

1609
01:02:26,230 --> 01:02:24,720
deployment from perseverance it did

1610
01:02:28,630 --> 01:02:26,240
and the biggest question has been do we

1611
01:02:30,710 --> 01:02:28,640
have enough energy do we have the solar

1612
01:02:31,430 --> 01:02:30,720
panel performance and the battery sizing

1613
01:02:33,430 --> 01:02:31,440

correct

1614
01:02:34,950 --> 01:02:33,440
and how do we estimate how much energy

1615
01:02:36,710 --> 01:02:34,960
it took to survive the night

1616
01:02:38,470 --> 01:02:36,720
we have received check marks for all of

1617
01:02:40,470 --> 01:02:38,480
them and the last few

1618
01:02:41,750 --> 01:02:40,480
solves has been about checking the rotor

1619
01:02:44,230 --> 01:02:41,760
system that

1620
01:02:46,230 --> 01:02:44,240
did the rotor system survive the journey

1621
01:02:47,109 --> 01:02:46,240
and is it there the way we launched it

1622
01:02:49,029 --> 01:02:47,119
from earth

1623
01:02:51,109 --> 01:02:49,039
so far it looks like it because you've

1624
01:02:53,349 --> 01:02:51,119
seen the 50 rpm spin

1625
01:02:54,710 --> 01:02:53,359
and then tonight is the big one when we

1626
01:02:56,710 --> 01:02:54,720
spin the full speed

1627
01:02:58,390 --> 01:02:56,720
uh on the surface still while on the

1628
01:02:59,029 --> 01:02:58,400
surface and that will ultimately check

1629
01:03:02,150 --> 01:02:59,039
that

1630
01:03:04,710 --> 01:03:02,160
launched it

1631
01:03:06,710 --> 01:03:04,720
if that is the case then the uncertainty

1632
01:03:08,150 --> 01:03:06,720
the only uncertainty remain the actual

1633
01:03:09,990 --> 01:03:08,160
environment of mars

1634
01:03:11,430 --> 01:03:10,000
so the winds and we talked a little bit

1635
01:03:12,630 --> 01:03:11,440
about it we've been talking to the meta

1636
01:03:15,910 --> 01:03:12,640
team cross-checking the

1637
01:03:18,710 --> 01:03:15,920
with the weather so depending on the win

1638
01:03:19,589 --> 01:03:18,720

and um we in that case will be pretty

1639
01:03:21,990 --> 01:03:19,599
confident

1640
01:03:22,870 --> 01:03:22,000
but uh again i want to be stay

1641
01:03:24,549 --> 01:03:22,880
conservative

1642
01:03:26,549 --> 01:03:24,559
we have never let ourselves surprise you

1643
01:03:27,349 --> 01:03:26,559
know celebrate so i'm really looking

1644
01:03:30,950 --> 01:03:27,359
forward to

1645
01:03:32,309 --> 01:03:30,960
sunday okay thanks mimi we have some

1646
01:03:35,990 --> 01:03:32,319
social questions coming

1647
01:03:36,710 --> 01:03:36,000
in as well um aaron on facebook wants to

1648
01:03:39,349 --> 01:03:36,720
say

1649
01:03:41,190 --> 01:03:39,359
hi from his nine-year-old son charlie

1650
01:03:44,710 --> 01:03:41,200
and charlie wants to know

1651
01:03:48,390 --> 01:03:44,720
do you have a mars helicopter 2.0

1652
01:03:52,630 --> 01:03:48,400
invented thomas would you like to

1653
01:03:54,309 --> 01:03:52,640
so hey hi back uh you know

1654
01:03:56,390 --> 01:03:54,319
i have to tell you we're thinking about

1655
01:03:58,309 --> 01:03:56,400
that right now and i'm sure i'm not the

1656
01:04:00,710 --> 01:03:58,319
only one who's thinking about it the one

1657
01:04:01,829 --> 01:04:00,720
thing you need to know is that we're

1658
01:04:03,829 --> 01:04:01,839
already working on

1659
01:04:05,109 --> 01:04:03,839
another craft and it's going to go to

1660
01:04:07,829 --> 01:04:05,119
this moon called

1661
01:04:09,510 --> 01:04:07,839
titan titan is actually different than

1662
01:04:11,990 --> 01:04:09,520
mars because of the fact that

1663
01:04:13,750 --> 01:04:12,000

actually if you go close to the the

1664
01:04:15,910 --> 01:04:13,760
ground of it

1665
01:04:17,510 --> 01:04:15,920
it that pressure is actually higher than

1666
01:04:19,829 --> 01:04:17,520
the pressure on earth

1667
01:04:21,510 --> 01:04:19,839
so it also is a rotor craft called

1668
01:04:22,230 --> 01:04:21,520
dragonfly by the way that's what it's

1669
01:04:25,349 --> 01:04:22,240
called go

1670
01:04:27,829 --> 01:04:25,359
google it figure it out go you know

1671
01:04:28,710 --> 01:04:27,839
it will it will also fly and explore

1672
01:04:31,990 --> 01:04:28,720
it's a much

1673
01:04:34,150 --> 01:04:32,000
heavier type of uh vehicle

1674
01:04:35,029 --> 01:04:34,160
but uh mimi i'm sure you're already

1675
01:04:37,910 --> 01:04:35,039
thinking about

1676
01:04:38,230 --> 01:04:37,920
uh you know the 2.0 uh and and your team

1677
01:04:45,109 --> 01:04:38,240
is

1678
01:04:48,230 --> 01:04:45,119
ongoing uh research uh with uh you know

1679
01:04:50,549 --> 01:04:48,240
led by jpl but part of the team jpl uh

1680
01:04:51,589 --> 01:04:50,559
in ames environment has been looking

1681
01:04:55,029 --> 01:04:51,599
into future

1682
01:04:57,190 --> 01:04:55,039
larger vehicles and the vision is

1683
01:04:59,349 --> 01:04:57,200
you know we have ingenuity 1.2 meter

1684
01:05:00,309 --> 01:04:59,359
diameter and future vehicles that have

1685
01:05:02,549 --> 01:05:00,319
been sized are

1686
01:05:04,230 --> 01:05:02,559
more three meters three and a half meter

1687
01:05:07,349 --> 01:05:04,240
diameter much larger

1688
01:05:08,470 --> 01:05:07,359

and in the 10 15 kilogram class able to

1689
01:05:11,349 --> 01:05:08,480
carry payloads

1690
01:05:12,870 --> 01:05:11,359
in a two kilogram level to make uh you

1691
01:05:15,910 --> 01:05:12,880
know significant exploration

1692
01:05:16,390 --> 01:05:15,920
so that kind of research is afoot and

1693
01:05:18,950 --> 01:05:16,400
yes

1694
01:05:19,829 --> 01:05:18,960
this is all about the future this is a

1695
01:05:21,670 --> 01:05:19,839
pathfinder

1696
01:05:23,270 --> 01:05:21,680
absolutely thank you sounds like an

1697
01:05:25,910 --> 01:05:23,280
exciting future ahead

1698
01:05:26,789 --> 01:05:25,920
up next on the phone lines is robert

1699
01:05:30,150 --> 01:05:26,799
holtz with

1700
01:05:30,710 --> 01:05:30,160
wall street journal i guess this is the

1701
01:05:33,990 --> 01:05:30,720
question

1702
01:05:34,549 --> 01:05:34,000
for mimi or perhaps tim you've said that

1703
01:05:38,710 --> 01:05:34,559
one of the

1704
01:05:40,549 --> 01:05:38,720
picking the time of the flight on sunday

1705
01:05:41,750 --> 01:05:40,559
are the wind conditions that you expect

1706
01:05:43,430 --> 01:05:41,760
in jezreel

1707
01:05:45,029 --> 01:05:43,440
crater based on measurements you've been

1708
01:05:48,390 --> 01:05:45,039
getting from meta

1709
01:05:50,390 --> 01:05:48,400
uh the onboard uh meteorological sensors

1710
01:05:51,430 --> 01:05:50,400
so i wonder if you can tell us uh you

1711
01:05:53,829 --> 01:05:51,440
know what

1712
01:05:55,510 --> 01:05:53,839
are the winds what's the range that

1713
01:05:57,750 --> 01:05:55,520

you've been getting in the crater

1714
01:05:59,910 --> 01:05:57,760
you say that you might encounter winds

1715
01:06:01,109 --> 01:05:59,920
higher there than you've tested for on

1716
01:06:03,270 --> 01:06:01,119
earth

1717
01:06:05,109 --> 01:06:03,280
what is the highest you've tested for on

1718
01:06:08,950 --> 01:06:05,119
earth and what does a martian

1719
01:06:10,630 --> 01:06:08,960
wind do in terms of flight control

1720
01:06:12,150 --> 01:06:10,640
challenges that might be different than

1721
01:06:15,430 --> 01:06:12,160
you'd experience on earth

1722
01:06:17,029 --> 01:06:15,440
the wind please thank you sure i can

1723
01:06:17,670 --> 01:06:17,039
start and then i'm going to let amy fill

1724
01:06:20,789 --> 01:06:17,680
in too

1725
01:06:21,190 --> 01:06:20,799
on the test so yes uh martian wind first

1726
01:06:24,309 --> 01:06:21,200
of all

1727
01:06:24,870 --> 01:06:24,319
impact um the the dynamics of the

1728
01:06:26,230 --> 01:06:24,880
vehicle

1729
01:06:28,230 --> 01:06:26,240
right so you we have a close loop

1730
01:06:30,950 --> 01:06:28,240
control system and it's the

1731
01:06:31,990 --> 01:06:30,960
disturbance that we do model uh

1732
01:06:35,190 --> 01:06:32,000
analytically

1733
01:06:35,910 --> 01:06:35,200
and we like to also test by exposing to

1734
01:06:39,589 --> 01:06:35,920
actual win

1735
01:06:42,150 --> 01:06:39,599
to confirm and so so far the meta

1736
01:06:43,510 --> 01:06:42,160
data is and this is very initial data

1737
01:06:46,549 --> 01:06:43,520
because meta team is

1738
01:06:47,190 --> 01:06:46,559

uh integra calibrating their information

1739
01:06:49,589 --> 01:06:47,200
and so

1740
01:06:51,029 --> 01:06:49,599
based on data the uncertainty because

1741
01:06:52,549 --> 01:06:51,039
it's so early in the game we have very

1742
01:06:54,870 --> 01:06:52,559
large uncertainty so

1743
01:06:56,390 --> 01:06:54,880
that the averages that uh we have

1744
01:06:59,109 --> 01:06:56,400
expected are

1745
01:07:00,069 --> 01:06:59,119
i believe around six meters per second

1746
01:07:02,309 --> 01:07:00,079
or or less

1747
01:07:04,390 --> 01:07:02,319
average but then you know you need to

1748
01:07:04,789 --> 01:07:04,400
add three sigma uncertainty to it

1749
01:07:06,069 --> 01:07:04,799
because

1750
01:07:08,710 --> 01:07:06,079
it is a very early part of the

1751
01:07:11,029 --> 01:07:08,720
calibration and so if you add three

1752
01:07:11,910 --> 01:07:11,039
sigma and the uncertainty it could be

1753
01:07:14,950 --> 01:07:11,920
high

1754
01:07:16,630 --> 01:07:14,960
around the 20 meter per second range

1755
01:07:18,069 --> 01:07:16,640
or it could be low i mean it's both

1756
01:07:19,589 --> 01:07:18,079
bounding right it could be much less

1757
01:07:21,990 --> 01:07:19,599
than 6 meters per second

1758
01:07:24,069 --> 01:07:22,000
it could be in the 20 meters per second

1759
01:07:25,349 --> 01:07:24,079
range the average is about 6 meters per

1760
01:07:28,630 --> 01:07:25,359
second or so

1761
01:07:30,390 --> 01:07:28,640
but we tested our system to 11 meters

1762
01:07:32,710 --> 01:07:30,400
per second that amy will describe

1763
01:07:33,589 --> 01:07:32,720

it's an art in itself but best for the

1764
01:07:36,549 --> 01:07:33,599
testing

1765
01:07:37,750 --> 01:07:36,559
now we also did the simulation under

1766
01:07:40,470 --> 01:07:37,760
hovard grip's uh

1767
01:07:41,349 --> 01:07:40,480
you know a team have simulated the close

1768
01:07:44,630 --> 01:07:41,359
loop

1769
01:07:45,910 --> 01:07:44,640
uh with winds up to you know close to 30

1770
01:07:48,710 --> 01:07:45,920
meters per second

1771
01:07:49,029 --> 01:07:48,720
and the close loop control has margin to

1772
01:07:52,950 --> 01:07:49,039
uh

1773
01:07:55,829 --> 01:07:52,960
higher perturbation

1774
01:07:56,390 --> 01:07:55,839
than what we were able to test so um

1775
01:07:58,309 --> 01:07:56,400
that's the

1776
01:07:59,750 --> 01:07:58,319
at earth you can only test so much and

1777
01:08:01,829 --> 01:07:59,760
our limit has been

1778
01:08:03,750 --> 01:08:01,839
how to set it up so amy i'm going to

1779
01:08:05,829 --> 01:08:03,760
hand it to over to you on amy was

1780
01:08:08,630 --> 01:08:05,839
actually in charge of this wind test so

1781
01:08:09,750 --> 01:08:08,640
so we did a wind test as part of our our

1782
01:08:13,029 --> 01:08:09,760
battery of tests

1783
01:08:13,670 --> 01:08:13,039
in that 25 foot space simulator what we

1784
01:08:16,070 --> 01:08:13,680
did to

1785
01:08:18,070 --> 01:08:16,080
generate this wind is we put together a

1786
01:08:18,950 --> 01:08:18,080
large bank of computer fans it was

1787
01:08:21,590 --> 01:08:18,960
actually

1788
01:08:22,309 --> 01:08:21,600

almost 900 of them can you imagine a

1789
01:08:24,709 --> 01:08:22,319
raid

1790
01:08:26,470 --> 01:08:24,719
blowing at this helicopter so we

1791
01:08:28,630 --> 01:08:26,480
achieved that 11 meters per second that

1792
01:08:29,110 --> 01:08:28,640
mimi was talking about our goal was at

1793
01:08:30,709 --> 01:08:29,120
least

1794
01:08:32,870 --> 01:08:30,719
10 meters per second when we put this

1795
01:08:34,630 --> 01:08:32,880
together so we were able to test the

1796
01:08:35,749 --> 01:08:34,640
controller against that speed which i

1797
01:08:38,709 --> 01:08:35,759
believe is above the

1798
01:08:43,349 --> 01:08:38,719
average that mimi uh quoted but not

1799
01:08:49,910 --> 01:08:46,630
great and up next is lisa grossman with

1800
01:08:53,110 --> 01:08:51,669
hi thanks for taking my question um i

1801
01:08:54,630 --> 01:08:53,120
was wondering about the specific

1802
01:08:56,789 --> 01:08:54,640
timeline for getting the video

1803
01:08:58,789 --> 01:08:56,799
and the images back to earth and back to

1804
01:09:00,229 --> 01:08:58,799
us and i was also wondering why there's

1805
01:09:02,470 --> 01:09:00,239
that checkerboard pattern on the rotor

1806
01:09:05,189 --> 01:09:02,480
blade

1807
01:09:07,110 --> 01:09:05,199
okay many people i'll leave it to elsa

1808
01:09:07,669 --> 01:09:07,120
and tim to answer the timeline and then

1809
01:09:11,110 --> 01:09:07,679
i can

1810
01:09:12,630 --> 01:09:11,120
take the checkerboard so okay yeah i

1811
01:09:15,349 --> 01:09:12,640
will start out and um

1812
01:09:16,390 --> 01:09:15,359
tim you can add some more detail we will

1813
01:09:18,789 --> 01:09:16,400

be getting

1814
01:09:20,789 --> 01:09:18,799
the first video snippets that i

1815
01:09:23,269 --> 01:09:20,799
described were like i mentioned

1816
01:09:25,829 --> 01:09:23,279
we were able to pick about somewhere

1817
01:09:29,030 --> 01:09:25,839
between 6 and 10 depending on our

1818
01:09:29,590 --> 01:09:29,040
results tonight we'll be picking those

1819
01:09:30,950 --> 01:09:29,600
out

1820
01:09:33,349 --> 01:09:30,960
each of those snippets are two and a

1821
01:09:33,990 --> 01:09:33,359
half seconds and we have to space them

1822
01:09:36,789 --> 01:09:34,000
about 20

1823
01:09:39,110 --> 01:09:36,799
seconds apart over the range of when we

1824
01:09:42,550 --> 01:09:39,120
think the flight could happen

1825
01:09:45,829 --> 01:09:42,560
so those will come down um

1826
01:09:49,349 --> 01:09:45,839
very close to midnight on monday

1827
01:09:51,829 --> 01:09:49,359
california time that is the images

1828
01:09:53,349 --> 01:09:51,839
there will also be about probably just

1829
01:09:57,350 --> 01:09:53,359
one image pair

1830
01:10:00,470 --> 01:09:57,360
um for from after the flight

1831
01:10:02,390 --> 01:10:00,480
we take images before the flight to

1832
01:10:03,830 --> 01:10:02,400
make sure that we have the how

1833
01:10:05,030 --> 01:10:03,840
everything was looking before the flight

1834
01:10:07,750 --> 01:10:05,040
then we take the video

1835
01:10:09,590 --> 01:10:07,760
during the flight and then after we take

1836
01:10:11,590 --> 01:10:09,600
a control image if you will and then we

1837
01:10:12,870 --> 01:10:11,600
can blink the before and after together

1838
01:10:15,030 --> 01:10:12,880

and see okay

1839
01:10:15,990 --> 01:10:15,040
how did those two compare that's of

1840
01:10:18,149 --> 01:10:16,000
course been

1841
01:10:19,830 --> 01:10:18,159
sitting on the surface right now until

1842
01:10:21,910 --> 01:10:19,840
now so those have been easy blinks that

1843
01:10:24,070 --> 01:10:21,920
you've seen with the with the rotors

1844
01:10:25,110 --> 01:10:24,080
rotating that's been the before and

1845
01:10:28,550 --> 01:10:25,120
after image that

1846
01:10:31,510 --> 01:10:28,560
we have been taking maybe an hour apart

1847
01:10:33,750 --> 01:10:31,520
and then more data will be trickling in

1848
01:10:37,350 --> 01:10:33,760
over the next days as we can

1849
01:10:38,950 --> 01:10:37,360
get more downlink from mars

1850
01:10:40,550 --> 01:10:38,960
overnight especially we have some very

1851
01:10:43,590 --> 01:10:40,560
big passes with the

1852
01:10:44,229 --> 01:10:43,600
with the tgo orbiter and we are just

1853
01:10:46,149 --> 01:10:44,239
taking

1854
01:10:48,390 --> 01:10:46,159
all the downlink we can get from all the

1855
01:10:51,350 --> 01:10:48,400
orbiters so we can get back as

1856
01:10:54,470 --> 01:10:51,360
much as possible and tim did you want to

1857
01:10:57,669 --> 01:10:56,470
no i think our pattern is similar we of

1858
01:10:58,950 --> 01:10:57,679
course are going to be taking these

1859
01:11:00,630 --> 01:10:58,960
images during our flight

1860
01:11:01,990 --> 01:11:00,640
and storing them on the storage that's

1861
01:11:04,229 --> 01:11:02,000
on the helicopter

1862
01:11:05,830 --> 01:11:04,239
but we're going to be downloading those

1863
01:11:06,709 --> 01:11:05,840

different images over the course of a

1864
01:11:08,709 --> 01:11:06,719
few days

1865
01:11:09,910 --> 01:11:08,719
as i mentioned earlier for the flight

1866
01:11:12,470 --> 01:11:09,920
itself we're going to be

1867
01:11:13,669 --> 01:11:12,480
downlinking one or two of those downward

1868
01:11:15,750 --> 01:11:13,679
facing

1869
01:11:17,110 --> 01:11:15,760
images as we come in for a landing that

1870
01:11:19,110 --> 01:11:17,120
way we can help figure out

1871
01:11:20,870 --> 01:11:19,120
exactly where the helicopter landed so

1872
01:11:22,550 --> 01:11:20,880
that will come down in a similar time

1873
01:11:24,950 --> 01:11:22,560
frame as the rest of the helicopter

1874
01:11:27,430 --> 01:11:24,960
performance data on that first saw

1875
01:11:28,229 --> 01:11:27,440
and then on those on the second saw

1876
01:11:30,709 --> 01:11:28,239
after

1877
01:11:32,149 --> 01:11:30,719
we will be downlinking that color image

1878
01:11:34,550 --> 01:11:32,159
so that we'll be able to look at that

1879
01:11:35,910 --> 01:11:34,560
and then on the on the saws after that

1880
01:11:38,310 --> 01:11:35,920
there are actually some more of those

1881
01:11:40,630 --> 01:11:38,320
black and white images that we took

1882
01:11:41,750 --> 01:11:40,640
actually while we're aloft because one

1883
01:11:43,590 --> 01:11:41,760
of the things we want to do

1884
01:11:45,350 --> 01:11:43,600
is to validate the algorithm used to

1885
01:11:46,630 --> 01:11:45,360
detect those features on the ground so

1886
01:11:48,229 --> 01:11:46,640
the so the engineering team of the

1887
01:11:49,830 --> 01:11:48,239
helicopter the guidance team

1888
01:11:52,070 --> 01:11:49,840

can take those images that we took a

1889
01:11:53,430 --> 01:11:52,080
loft look at the features and then look

1890
01:11:55,189 --> 01:11:53,440
at that high

1891
01:11:57,590 --> 01:11:55,199
rate telemetry that we took that is

1892
01:11:59,830 --> 01:11:57,600
actually telling us what features it

1893
01:12:01,270 --> 01:11:59,840
thought it saw and able to correlate

1894
01:12:03,910 --> 01:12:01,280
that with the images that we took

1895
01:12:05,350 --> 01:12:03,920
and then see how well they're all going

1896
01:12:07,030 --> 01:12:05,360
to perform but it's going to be a

1897
01:12:09,030 --> 01:12:07,040
multi-saw operation

1898
01:12:10,709 --> 01:12:09,040
and the most important one on that first

1899
01:12:11,669 --> 01:12:10,719
saw is that one black and white that

1900
01:12:15,590 --> 01:12:11,679
will help us

1901
01:12:21,910 --> 01:12:19,350
and uh to the uh question on the blade

1902
01:12:22,470 --> 01:12:21,920
uh very absolutely those grips are there

1903
01:12:25,669 --> 01:12:22,480
and

1904
01:12:28,470 --> 01:12:25,679
it's all comes from mass constraint for

1905
01:12:29,910 --> 01:12:28,480
eight 1.8 kilograms is 1800 grams with

1906
01:12:33,110 --> 01:12:29,920
so many components

1907
01:12:35,430 --> 01:12:33,120
every bit mattered right so the blades

1908
01:12:36,149 --> 01:12:35,440
themselves are i believe about 35 grams

1909
01:12:38,709 --> 01:12:36,159
it's really

1910
01:12:40,070 --> 01:12:38,719
really light they just look big and long

1911
01:12:42,790 --> 01:12:40,080
but they're really light

1912
01:12:43,590 --> 01:12:42,800
and the whey was built was a foam core

1913
01:12:46,550 --> 01:12:43,600

in the middle

1914
01:12:46,870 --> 01:12:46,560
with carbon fiber layup so that we could

1915
01:12:49,510 --> 01:12:46,880
have

1916
01:12:50,310 --> 01:12:49,520
both the light weight but still the

1917
01:12:53,030 --> 01:12:50,320
strength

1918
01:12:55,110 --> 01:12:53,040
uh to be able to push then then as the

1919
01:12:56,790 --> 01:12:55,120
atmosphere is you're still pushing 2400

1920
01:12:59,110 --> 01:12:56,800
2500 rpm right

1921
01:13:00,950 --> 01:12:59,120
and so it has to be strong and also from

1922
01:13:02,470 --> 01:13:00,960
the controls perspective for modeling

1923
01:13:04,550 --> 01:13:02,480
and testing that we talk about

1924
01:13:05,669 --> 01:13:04,560
you know to do in the chamber it had to

1925
01:13:07,750 --> 01:13:05,679
also be stiff

1926
01:13:10,070 --> 01:13:07,760
so that we really had a way to confirm

1927
01:13:12,310 --> 01:13:10,080
our models before we actually even tried

1928
01:13:13,270 --> 01:13:12,320
a test flight in the chamber so for

1929
01:13:15,430 --> 01:13:13,280
stiffness

1930
01:13:16,630 --> 01:13:15,440
strength and light weight the carbon

1931
01:13:19,110 --> 01:13:16,640
fiber layup

1932
01:13:20,870 --> 01:13:19,120
was used also above the foam and is

1933
01:13:21,669 --> 01:13:20,880
cross patterned to give it the most

1934
01:13:23,750 --> 01:13:21,679
strength

1935
01:13:24,950 --> 01:13:23,760
so that's the reason for the cross

1936
01:13:27,189 --> 01:13:24,960
pattern that you're seeing

1937
01:13:28,229 --> 01:13:27,199
instead of going fibers in parallel the

1938
01:13:30,470 --> 01:13:28,239

cross pattern

1939
01:13:32,229 --> 01:13:30,480
really gives it additional strength and

1940
01:13:34,630 --> 01:13:32,239
error environment did a fantastic

1941
01:13:36,390 --> 01:13:34,640
job you know building this blade so

1942
01:13:37,750 --> 01:13:36,400
first it was carefully designed with the

1943
01:13:39,830 --> 01:13:37,760
twist core distribution

1944
01:13:42,229 --> 01:13:39,840
and then fabricated fabulously with

1945
01:13:44,790 --> 01:13:42,239
these requirements

1946
01:13:45,270 --> 01:13:44,800
thank you and up next is alexander witz

1947
01:13:48,470 --> 01:13:45,280
with

1948
01:13:50,310 --> 01:13:48,480
nature magazine hi

1949
01:13:53,270 --> 01:13:50,320
i just want to follow up real briefly on

1950
01:13:55,270 --> 01:13:53,280
lisa's question about the timing

1951
01:13:57,350 --> 01:13:55,280
there's a difference between images and

1952
01:13:58,070 --> 01:13:57,360
video downlinking and images and video

1953
01:14:00,790 --> 01:13:58,080
being

1954
01:14:02,470 --> 01:14:00,800
released to the public do we anticipate

1955
01:14:03,270 --> 01:14:02,480
getting any images released to the

1956
01:14:05,350 --> 01:14:03,280
public

1957
01:14:09,350 --> 01:14:05,360
prior to that 8 a.m press conference on

1958
01:14:12,950 --> 01:14:11,669
so so this is thomas i'm going to start

1959
01:14:15,430 --> 01:14:12,960
and i'm going to kick it over

1960
01:14:17,110 --> 01:14:15,440
our intent is to keep the pipeline open

1961
01:14:19,990 --> 01:14:17,120
just the way we have in the past

1962
01:14:20,709 --> 01:14:20,000
so so basically the images as they come

1963
01:14:22,310 --> 01:14:20,719

down

1964
01:14:24,390 --> 01:14:22,320
they will go into the pipeline and

1965
01:14:27,110 --> 01:14:24,400
they'll they'll be uh they'll be open

1966
01:14:28,550 --> 01:14:27,120
there may be some technical reasons that

1967
01:14:30,310 --> 01:14:28,560
something is slightly delayed and i'll

1968
01:14:32,950 --> 01:14:30,320
open it up for you

1969
01:14:33,510 --> 01:14:32,960
to add to that but uh the principle is

1970
01:14:36,149 --> 01:14:33,520
that we're

1971
01:14:37,750 --> 01:14:36,159
you know after uh you know i hope many

1972
01:14:40,709 --> 01:14:37,760
of you will join us

1973
01:14:41,110 --> 01:14:40,719
as we on nasa.gov slash live as we kind

1974
01:14:43,830 --> 01:14:41,120
of

1975
01:14:44,950 --> 01:14:43,840
join the team uh and uh during this

1976
01:14:47,110 --> 01:14:44,960
historic moment

1977
01:14:48,229 --> 01:14:47,120
there will be some images there uh the

1978
01:14:49,910 --> 01:14:48,239
images will come in

1979
01:14:51,350 --> 01:14:49,920
and uh by the time we do the press

1980
01:14:53,510 --> 01:14:51,360
conference uh the

1981
01:14:55,350 --> 01:14:53,520
will uh you know we'll pull together uh

1982
01:14:57,830 --> 01:14:55,360
the best way we know how

1983
01:14:59,110 --> 01:14:57,840
but but i'm sure others will try

1984
01:14:59,510 --> 01:14:59,120
themselves with the images that are

1985
01:15:01,750 --> 01:14:59,520
there

1986
01:15:03,910 --> 01:15:01,760
the pipeline will be open alex go ahead

1987
01:15:07,030 --> 01:15:03,920
if anybody wants to add anything

1988
01:15:08,149 --> 01:15:07,040

yes i'll just add a few snippets to that

1989
01:15:11,270 --> 01:15:08,159
which is

1990
01:15:13,350 --> 01:15:11,280
our team is going to be pouncing on the

1991
01:15:16,149 --> 01:15:13,360
data as it comes in you know we are

1992
01:15:17,750 --> 01:15:16,159
just looking at as as soon as it comes

1993
01:15:20,310 --> 01:15:17,760
in as soon as it starts to hit

1994
01:15:21,030 --> 01:15:20,320
in fact as it comes in from the orbiters

1995
01:15:23,590 --> 01:15:21,040
we're already

1996
01:15:27,030 --> 01:15:23,600
starting to look at and of course our

1997
01:15:30,950 --> 01:15:29,110
priority is to make sure everything

1998
01:15:32,790 --> 01:15:30,960
worked as expected that the cameras are

1999
01:15:34,070 --> 01:15:32,800
working that everything is healthy we do

2000
01:15:36,630 --> 01:15:34,080
that every single day

2001
01:15:37,990 --> 01:15:36,640
but on this occasion and especially

2002
01:15:41,430 --> 01:15:38,000
we're going to look for

2003
01:15:43,830 --> 01:15:41,440
those first images post-flight to also

2004
01:15:44,470 --> 01:15:43,840
help in the ascertaining of the success

2005
01:15:46,950 --> 01:15:44,480
of it

2006
01:15:47,990 --> 01:15:46,960
and then the video snippets that we hope

2007
01:15:51,510 --> 01:15:48,000
will

2008
01:15:52,950 --> 01:15:51,520
catch part of the flight so

2009
01:15:55,189 --> 01:15:52,960
that's the one that comes in right after

2010
01:15:56,870 --> 01:15:55,199
midnight and it's always such a precious

2011
01:15:59,030 --> 01:15:56,880
downlink because as we call it's

2012
01:16:00,310 --> 01:15:59,040
decisional which means that it can go

2013
01:16:02,390 --> 01:16:00,320

into

2014
01:16:03,510 --> 01:16:02,400
decision making for the next day and

2015
01:16:05,910 --> 01:16:03,520
then orbiters

2016
01:16:07,110 --> 01:16:05,920
and there'll be other orbiter downlinks

2017
01:16:10,149 --> 01:16:07,120
throughout

2018
01:16:13,510 --> 01:16:10,159
the day on monday to

2019
01:16:16,229 --> 01:16:13,520
add to the pot if you will

2020
01:16:18,070 --> 01:16:16,239
there is of course we have to actually

2021
01:16:19,110 --> 01:16:18,080
collect the zeros and ones and create

2022
01:16:23,110 --> 01:16:19,120
images

2023
01:16:26,550 --> 01:16:23,120
so there's a few minutes of delay

2024
01:16:28,229 --> 01:16:26,560
before it gets to the public website but

2025
01:16:30,630 --> 01:16:28,239
otherwise we are just trying to get it

2026
01:16:33,990 --> 01:16:30,640
out to the public as quickly as possible

2027
01:16:37,189 --> 01:16:34,000
so go to the jpl raw images website

2028
01:16:40,310 --> 01:16:37,199
and i know that they'll also be you know

2029
01:16:43,430 --> 01:16:40,320
our science team other science team

2030
01:16:46,070 --> 01:16:43,440
members and justin mackey jpl

2031
01:16:46,790 --> 01:16:46,080
will be standing by he's one of our top

2032
01:16:50,790 --> 01:16:46,800
image

2033
01:16:52,790 --> 01:16:50,800
he's one of the top processors of data

2034
01:16:54,470 --> 01:16:52,800
he's the one you've always seen when we

2035
01:16:55,270 --> 01:16:54,480
land he's the first one to bring up an

2036
01:16:57,669 --> 01:16:55,280
image

2037
01:16:58,390 --> 01:16:57,679
he'll be there at the press conference

2038
01:17:00,630 --> 01:16:58,400

to serve

2039
01:17:01,430 --> 01:17:00,640
everybody up with the latest images that

2040
01:17:05,510 --> 01:17:01,440
we have

2041
01:17:07,430 --> 01:17:05,520
so there will be images um very quickly

2042
01:17:08,790 --> 01:17:07,440
i can't say the timeline exactly because

2043
01:17:11,590 --> 01:17:08,800
we will simply

2044
01:17:13,669 --> 01:17:11,600
process it and give it out to you guys

2045
01:17:15,189 --> 01:17:13,679
as soon as we can

2046
01:17:17,030 --> 01:17:15,199
so if you don't mind i'll go one more

2047
01:17:20,470 --> 01:17:17,040
time and i just want to

2048
01:17:21,430 --> 01:17:20,480
just ask you all who are excited about

2049
01:17:24,070 --> 01:17:21,440
these images

2050
01:17:25,430 --> 01:17:24,080
for patience in a sense that you know

2051
01:17:27,110 --> 01:17:25,440
the good people that that you hear

2052
01:17:28,310 --> 01:17:27,120
talking about it and their entire teams

2053
01:17:30,630 --> 01:17:28,320
will work

2054
01:17:32,790 --> 01:17:30,640
at whatever is the the speed that they

2055
01:17:34,790 --> 01:17:32,800
can to get this out but just

2056
01:17:36,550 --> 01:17:34,800
because of the sheer amount of images

2057
01:17:38,790 --> 01:17:36,560
you know there will be

2058
01:17:39,910 --> 01:17:38,800
some uh delays obviously but it's not

2059
01:17:42,229 --> 01:17:39,920
because of

2060
01:17:43,910 --> 01:17:42,239
any other reason than uh the team needs

2061
01:17:44,709 --> 01:17:43,920
to work through it and make the data

2062
01:17:47,030 --> 01:17:44,719
useful as

2063
01:17:49,030 --> 01:17:47,040

as it gets out so i just want to ask the

2064
01:17:52,229 --> 01:17:49,040
public for patience as we

2065
01:17:55,110 --> 01:17:52,239
work through this again during this uh

2066
01:17:55,590 --> 01:17:55,120
pandemic period and that that still at

2067
01:17:57,270 --> 01:17:55,600
times

2068
01:17:59,270 --> 01:17:57,280
makes it a little bit harder to get

2069
01:18:02,229 --> 01:17:59,280
things out just want to tell you that

2070
01:18:04,470 --> 01:18:02,239
we the team have been just so proud of

2071
01:18:06,390 --> 01:18:04,480
what the team has done from the moment

2072
01:18:07,990 --> 01:18:06,400
uh we have landed on mars kind of

2073
01:18:11,270 --> 01:18:08,000
getting these pipelines

2074
01:18:13,430 --> 01:18:11,280
uh opened there and uh and getting uh so

2075
01:18:15,590 --> 01:18:13,440
many excited around the entire

2076
01:18:16,709 --> 01:18:15,600
earth earth you know getting excited

2077
01:18:19,350 --> 01:18:16,719
working with

2078
01:18:21,430 --> 01:18:19,360
uh with data and trying themselves to

2079
01:18:22,310 --> 01:18:21,440
find a new thing out new things about

2080
01:18:23,830 --> 01:18:22,320
mars

2081
01:18:25,430 --> 01:18:23,840
that's right and i also want to add

2082
01:18:27,510 --> 01:18:25,440
actually your your comments are

2083
01:18:29,189 --> 01:18:27,520
reminding me how much we actually enjoy

2084
01:18:29,830 --> 01:18:29,199
the interaction with the public about

2085
01:18:31,910 --> 01:18:29,840
this

2086
01:18:33,590 --> 01:18:31,920
you know we're seeing our images go out

2087
01:18:35,430 --> 01:18:33,600
and immediately people are creating

2088
01:18:36,070 --> 01:18:35,440

mosaics from the images or they're

2089
01:18:38,870 --> 01:18:36,080
creating

2090
01:18:40,070 --> 01:18:38,880
their own enhancements of the images and

2091
01:18:42,390 --> 01:18:40,080
we really enjoy that

2092
01:18:43,189 --> 01:18:42,400
you know we look at those images as well

2093
01:18:45,990 --> 01:18:43,199
we talk about

2094
01:18:46,950 --> 01:18:46,000
hey did you see so and so did did this

2095
01:18:49,590 --> 01:18:46,960
um

2096
01:18:51,750 --> 01:18:49,600
and in in a sense you know we are

2097
01:18:54,870 --> 01:18:51,760
immediately sharing our data

2098
01:18:56,550 --> 01:18:54,880
our gold from mars

2099
01:18:58,630 --> 01:18:56,560
with everybody and that's part of the

2100
01:18:59,350 --> 01:18:58,640
experience for us is that we get to

2101
01:19:03,430 --> 01:18:59,360
share it

2102
01:19:05,830 --> 01:19:03,440
it gives such a such a perspective to us

2103
01:19:07,990 --> 01:19:05,840
you know we are we have really cool jobs

2104
01:19:10,070 --> 01:19:08,000
i think we can all agree on that

2105
01:19:11,510 --> 01:19:10,080
but we are like nose to the groundstone

2106
01:19:13,110 --> 01:19:11,520
every day working on this

2107
01:19:14,630 --> 01:19:13,120
and so when we get to share with the

2108
01:19:16,950 --> 01:19:14,640
public today and

2109
01:19:18,709 --> 01:19:16,960
all the times when we send out data that

2110
01:19:20,550 --> 01:19:18,719
gives us that perspective that gives us

2111
01:19:23,990 --> 01:19:20,560
that connection with the public

2112
01:19:26,310 --> 01:19:24,000
and my pi um jim bell who used to be the

2113
01:19:29,270 --> 01:19:26,320

president of the planetary society

2114
01:19:30,310 --> 01:19:29,280
is hugely supportive and engaged in

2115
01:19:32,470 --> 01:19:30,320
public outreach

2116
01:19:33,590 --> 01:19:32,480
and it's just a part and parcel of our

2117
01:19:36,550 --> 01:19:33,600
team so

2118
01:19:37,510 --> 01:19:36,560
go to our website too go to the nasa raw

2119
01:19:40,390 --> 01:19:37,520
images website

2120
01:19:41,910 --> 01:19:40,400
we are starting a favorites area of our

2121
01:19:44,550 --> 01:19:41,920
website

2122
01:19:45,430 --> 01:19:44,560
that we know hope and no will grow over

2123
01:19:47,669 --> 01:19:45,440
time

2124
01:19:49,990 --> 01:19:47,679
and we've also encouraged input actually

2125
01:19:51,830 --> 01:19:50,000
from the public to that website

2126
01:19:53,430 --> 01:19:51,840
so just like i worked on the juno

2127
01:19:55,430 --> 01:19:53,440
mission as well

2128
01:19:57,830 --> 01:19:55,440
and that's one of the missions that

2129
01:19:59,910 --> 01:19:57,840
pioneered the the input of

2130
01:20:01,510 --> 01:19:59,920
public images to the website the

2131
01:20:03,350 --> 01:20:01,520
official website we're doing that with

2132
01:20:06,149 --> 01:20:03,360
masscamz as well

2133
01:20:07,590 --> 01:20:06,159
and we just we want to see what you guys

2134
01:20:10,149 --> 01:20:07,600
are doing we want to see

2135
01:20:12,310 --> 01:20:10,159
how you are relating to our data and

2136
01:20:15,830 --> 01:20:12,320
what you get out of it so

2137
01:20:16,870 --> 01:20:15,840
stay in touch thank you and that website

2138
01:20:19,990 --> 01:20:16,880

they are mentioning

2139
01:20:23,750 --> 01:20:20,000
is go.nasa.gov

2140
01:20:26,709 --> 01:20:23,760
perseverance dash raw dash images

2141
01:20:28,470 --> 01:20:26,719
we will again run it at the end of this

2142
01:20:28,790 --> 01:20:28,480
broadcast so you will be able to see

2143
01:20:31,750 --> 01:20:28,800
this

2144
01:20:31,990 --> 01:20:31,760
link once more towards the end but we do

2145
01:20:34,229 --> 01:20:32,000
have

2146
01:20:35,669 --> 01:20:34,239
the phone lines up still open and up

2147
01:20:39,510 --> 01:20:35,679
next is jeff faust

2148
01:20:42,790 --> 01:20:39,520
with space news

2149
01:20:43,510 --> 01:20:42,800
hi question for mimi assuming that this

2150
01:20:47,750 --> 01:20:43,520
flight

2151
01:20:49,110 --> 01:20:47,760
sunday goes as planned and successful

2152
01:20:51,990 --> 01:20:49,120
how soon do you think you would be ready

2153
01:20:54,470 --> 01:20:52,000
to perform a second flight what is the

2154
01:20:55,270 --> 01:20:54,480
process to review the data from this

2155
01:20:57,750 --> 01:20:55,280
first flight

2156
01:20:58,950 --> 01:20:57,760
and then plan for the second presumably

2157
01:21:02,310 --> 01:20:58,960
more ambitious flight

2158
01:21:05,510 --> 01:21:02,320
thanks excellent yes the

2159
01:21:08,629 --> 01:21:05,520
the cadence uh between flights uh

2160
01:21:09,510 --> 01:21:08,639
will be four days uh after the first

2161
01:21:11,669 --> 01:21:09,520
flight

2162
01:21:13,030 --> 01:21:11,679
and then if uh you know we are happy

2163
01:21:15,750 --> 01:21:13,040

with that we'll go on to

2164
01:21:16,709 --> 01:21:15,760
three-day cadence so meaning after the

2165
01:21:18,629 --> 01:21:16,719
first flight

2166
01:21:21,030 --> 01:21:18,639
we're going to let the vehicle have a

2167
01:21:24,070 --> 01:21:21,040
rest day so that we can again

2168
01:21:25,350 --> 01:21:24,080
confirm the energy model uh after its

2169
01:21:27,430 --> 01:21:25,360
very first flight

2170
01:21:29,430 --> 01:21:27,440
so that's a different you know just for

2171
01:21:31,590 --> 01:21:29,440
the first flight and we start as

2172
01:21:33,350 --> 01:21:31,600
tim cannon mentioned we start to bring

2173
01:21:35,510 --> 01:21:33,360
our high rate data back

2174
01:21:37,350 --> 01:21:35,520
over the two days after that and that's

2175
01:21:38,790 --> 01:21:37,360
where our treasure is and i have to

2176
01:21:41,110 --> 01:21:38,800
emphasize this

2177
01:21:42,310 --> 01:21:41,120
it really is about the engineering data

2178
01:21:44,070 --> 01:21:42,320
as much as we can

2179
01:21:45,830 --> 01:21:44,080
to confirm our model so that's when we

2180
01:21:48,550 --> 01:21:45,840
get our you know flight sensor

2181
01:21:50,229 --> 01:21:48,560
uh all how well do we perform as well as

2182
01:21:50,870 --> 01:21:50,239
that icing those color pictures will

2183
01:21:53,910 --> 01:21:50,880
come in

2184
01:21:55,990 --> 01:21:53,920
so rest after the first flight rest

2185
01:21:57,990 --> 01:21:56,000
and then uh for the vehicle rest and we

2186
01:21:59,990 --> 01:21:58,000
won't be we look at all the data

2187
01:22:01,430 --> 01:22:00,000
see how the performance well and we will

2188
01:22:03,669 --> 01:22:01,440

be ready to fly

2189
01:22:04,470 --> 01:22:03,679
the fourth day after the first flight

2190
01:22:08,310 --> 01:22:04,480
and

2191
01:22:10,470 --> 01:22:08,320
we will just be in three day cadence

2192
01:22:11,430 --> 01:22:10,480
fly the next day get the first set of

2193
01:22:13,110 --> 01:22:11,440
high rate data

2194
01:22:14,629 --> 01:22:13,120
and then the next day after that get the

2195
01:22:17,430 --> 01:22:14,639
last bit of the high rate data

2196
01:22:19,030 --> 01:22:17,440
and in those uh three days two days

2197
01:22:21,430 --> 01:22:19,040
following will be ready for the third

2198
01:22:24,709 --> 01:22:21,440
flight the fourth flight et cetera

2199
01:22:26,709 --> 01:22:24,719
so oh in terms of more ambitious flight

2200
01:22:28,070 --> 01:22:26,719
absolutely we will be we're going as tim

2201
01:22:30,070 --> 01:22:28,080
mentioned we'll go up to

2202
01:22:31,750 --> 01:22:30,080
three meters in hover but in the future

2203
01:22:34,149 --> 01:22:31,760
ones we'll go up to five meters

2204
01:22:35,830 --> 01:22:34,159
start going laterally first modestly and

2205
01:22:38,550 --> 01:22:35,840
then we'll go on further to

2206
01:22:40,790 --> 01:22:38,560
you know 50 meter out and back and then

2207
01:22:43,110 --> 01:22:40,800
once we get to fourth and fifth flight

2208
01:22:44,790 --> 01:22:43,120
we'll have fun we really want to thomas

2209
01:22:45,430 --> 01:22:44,800
we really want to push our vehicle to

2210
01:22:48,149 --> 01:22:45,440
the limit

2211
01:22:48,950 --> 01:22:48,159
it's not every day that you get to test

2212
01:22:51,750 --> 01:22:48,960
a rotorcraft

2213
01:22:53,030 --> 01:22:51,760

and do an experiment on mars so after

2214
01:22:55,189 --> 01:22:53,040
the third flight uh

2215
01:22:58,390 --> 01:22:55,199
this morning we are going to be very uh

2216
01:23:00,870 --> 01:22:58,400
adventurous oh crazy with it yeah

2217
01:23:02,709 --> 01:23:00,880
well thank you for that answer mimi and

2218
01:23:03,350 --> 01:23:02,719
we have a social media question coming

2219
01:23:06,149 --> 01:23:03,360
in

2220
01:23:06,629 --> 01:23:06,159
tim on facebook asks will the weather

2221
01:23:10,070 --> 01:23:06,639
station

2222
01:23:13,990 --> 01:23:10,080
on the rover allow or deny the flight

2223
01:23:17,669 --> 01:23:14,000
if wind is excessive so

2224
01:23:21,189 --> 01:23:19,669
sure well hello tim this is tim nice to

2225
01:23:23,750 --> 01:23:21,199
meet you um

2226
01:23:24,390 --> 01:23:23,760
so the meta instrument has its own data

2227
01:23:26,550 --> 01:23:24,400
set that

2228
01:23:28,470 --> 01:23:26,560
again follows a path the word where they

2229
01:23:29,990 --> 01:23:28,480
take they take the data and then they

2230
01:23:31,669 --> 01:23:30,000
downlink it to earth and the meta team

2231
01:23:33,910 --> 01:23:31,679
decodes all that data

2232
01:23:36,070 --> 01:23:33,920
on their own so the weather on mars

2233
01:23:37,189 --> 01:23:36,080
tends to be more or less the same across

2234
01:23:38,709 --> 01:23:37,199
many saws

2235
01:23:40,390 --> 01:23:38,719
so when we get a weather report as a

2236
01:23:43,189 --> 01:23:40,400
team it's really

2237
01:23:44,629 --> 01:23:43,199
getting a history of the weather plus

2238
01:23:45,830 --> 01:23:44,639

those wind predictions that mimi

2239
01:23:47,270 --> 01:23:45,840
mentioned

2240
01:23:49,430 --> 01:23:47,280
so because it's really these two

2241
01:23:51,350 --> 01:23:49,440
separate teams processing their data

2242
01:23:53,189 --> 01:23:51,360
the weather station on the rover has no

2243
01:23:55,590 --> 01:23:53,199
decision making process

2244
01:23:57,110 --> 01:23:55,600
on the day of the flight to stop or

2245
01:23:57,750 --> 01:23:57,120
allow the flight there's no there's no

2246
01:23:59,830 --> 01:23:57,760
connection

2247
01:24:01,189 --> 01:23:59,840
on board the rover where the weather

2248
01:24:02,470 --> 01:24:01,199
station can tell the helicopter you

2249
01:24:04,310 --> 01:24:02,480
can't fly today

2250
01:24:05,990 --> 01:24:04,320
so that connection isn't there relies on

2251
01:24:08,229 --> 01:24:06,000
the experts on the ground on both teams

2252
01:24:11,189 --> 01:24:08,239
to decode the data and come to these

2253
01:24:14,709 --> 01:24:11,199
reasoned engineering judgments as to

2254
01:24:18,070 --> 01:24:16,390
great thank you tim and we have another

2255
01:24:20,870 --> 01:24:18,080
social media question

2256
01:24:22,390 --> 01:24:20,880
javi on facebook asks what is the speed

2257
01:24:25,270 --> 01:24:22,400
of sound on mars

2258
01:24:30,790 --> 01:24:25,280
and can the tip of the ingenuity blades

2259
01:24:33,830 --> 01:24:30,800
exceed the speed amy

2260
01:24:37,910 --> 01:24:33,840
yeah uh we are going to be flying at uh

2261
01:24:40,709 --> 01:24:37,920
about 0.6 mark on on mars

2262
01:24:42,310 --> 01:24:40,719
and i've done this math before but i

2263
01:24:44,390 --> 01:24:42,320

don't remember the number

2264
01:24:46,709 --> 01:24:44,400
thomas if you remember but if you look

2265
01:24:50,310 --> 01:24:46,719
up just calculate but it will be about

2266
01:24:54,149 --> 01:24:50,320
0.6 0.6 the speed of sound is how the

2267
01:24:55,990 --> 01:24:54,159
tip speed will be and so um

2268
01:24:57,910 --> 01:24:56,000
you can google it i have looked it up

2269
01:24:59,990 --> 01:24:57,920
and i just don't remember the number

2270
01:25:01,590 --> 01:25:00,000
so yes please look it up point six mark

2271
01:25:04,390 --> 01:25:01,600
on mars good question

2272
01:25:06,070 --> 01:25:04,400
and yes the entire design for the how

2273
01:25:07,030 --> 01:25:06,080
fast you know the upper limit on how

2274
01:25:09,990 --> 01:25:07,040
fast we can

2275
01:25:10,950 --> 01:25:10,000
a spin right in calculate in designing

2276
01:25:13,590 --> 01:25:10,960
the entire system

2277
01:25:14,550 --> 01:25:13,600
we took the speed of sound at mars into

2278
01:25:15,910 --> 01:25:14,560
account

2279
01:25:17,750 --> 01:25:15,920
great thanks mimi we'll work on getting

2280
01:25:19,830 --> 01:25:17,760
you those exact numbers up next on the

2281
01:25:23,669 --> 01:25:19,840
phone line is matt kaplan from

2282
01:25:24,149 --> 01:25:23,679
planetary radio hi everyone thank you

2283
01:25:25,669 --> 01:25:24,159
for this

2284
01:25:28,070 --> 01:25:25,679
really thrilled looking forward to

2285
01:25:31,030 --> 01:25:28,080
sunday going back to

2286
01:25:32,870 --> 01:25:31,040
thomas's comment about dragonfly that

2287
01:25:33,830 --> 01:25:32,880
maybe mars and titan don't have a lot in

2288
01:25:36,870 --> 01:25:33,840

common but

2289
01:25:37,910 --> 01:25:36,880
mimi i'm wondering if you are trading

2290
01:25:40,149 --> 01:25:37,920
information

2291
01:25:42,629 --> 01:25:40,159
with those folks and uh i'm sure they

2292
01:25:45,189 --> 01:25:42,639
have high hopes for your success

2293
01:25:46,390 --> 01:25:45,199
oh uh yes uh in fact uh michael

2294
01:25:49,430 --> 01:25:46,400
rickskivich

2295
01:25:53,030 --> 01:25:49,440
who leads the space division in apl

2296
01:25:55,030 --> 01:25:53,040
where um dragonfly is being developed uh

2297
01:25:56,310 --> 01:25:55,040
michael riskiewicz was our independent

2298
01:25:59,510 --> 01:25:56,320
review team chair

2299
01:26:01,189 --> 01:25:59,520
throughout the lifetime of uh ingenuity

2300
01:26:03,350 --> 01:26:01,199
mars helicopter development over the

2301
01:26:06,790 --> 01:26:03,360
years so yes and

2302
01:26:08,709 --> 01:26:06,800
you know while um dragonfly is flying in

2303
01:26:10,070 --> 01:26:08,719
the thicker atmosphere

2304
01:26:12,070 --> 01:26:10,080
right so it's a different kind of

2305
01:26:14,390 --> 01:26:12,080
vehicle it's heavier uh

2306
01:26:15,110 --> 01:26:14,400
at mars it's all about being light uh

2307
01:26:17,030 --> 01:26:15,120
and you know more

2308
01:26:18,149 --> 01:26:17,040
autonomous and it's it's a different

2309
01:26:21,030 --> 01:26:18,159
kind of challenge

2310
01:26:22,950 --> 01:26:21,040
however uh where we can uh learn from

2311
01:26:25,990 --> 01:26:22,960
each other is

2312
01:26:28,870 --> 01:26:26,000
uh with being the first rotograph in

2313
01:26:29,270 --> 01:26:28,880

a flying vehicle on another planet or in

2314
01:26:31,189 --> 01:26:29,280
in

2315
01:26:33,430 --> 01:26:31,199
the case you know at around the moon

2316
01:26:35,510 --> 01:26:33,440
with atmosphere but not at earth

2317
01:26:37,110 --> 01:26:35,520
it has been a challenge that amy

2318
01:26:39,510 --> 01:26:37,120
described and i think

2319
01:26:40,149 --> 01:26:39,520
and describe more how do you test this

2320
01:26:41,910 --> 01:26:40,159
vehicle

2321
01:26:43,830 --> 01:26:41,920
right so you have the fundamental models

2322
01:26:46,229 --> 01:26:43,840
yes you spin you generate lift

2323
01:26:47,830 --> 01:26:46,239
and control fast enough you can fly

2324
01:26:49,910 --> 01:26:47,840
easier said than done right

2325
01:26:51,350 --> 01:26:49,920
how do we go about testing it and we've

2326
01:26:53,350 --> 01:26:51,360
had incremental

2327
01:26:54,950 --> 01:26:53,360
steps in how do you spin it how do you

2328
01:26:56,550 --> 01:26:54,960
you know measure the force

2329
01:26:58,470 --> 01:26:56,560
check the torque cancellation i think

2330
01:26:59,189 --> 01:26:58,480
that methodology that we've had to

2331
01:27:03,910 --> 01:26:59,199
invent

2332
01:27:05,750 --> 01:27:03,920
vehicle for a planetary exploration uh

2333
01:27:08,229 --> 01:27:05,760
that will be very much applicable

2334
01:27:09,590 --> 01:27:08,239
and uh michael rickskievich is very

2335
01:27:10,709 --> 01:27:09,600
familiar and i'm sure we'll be

2336
01:27:12,790 --> 01:27:10,719
interacting further

2337
01:27:16,709 --> 01:27:12,800
as they go into the vnb phase we've had

2338
01:27:19,990 --> 01:27:18,629

thank you and up next on the phone lines

2339
01:27:23,669 --> 01:27:20,000
is dan sweet

2340
01:27:26,950 --> 01:27:25,110
uh good afternoon i appreciate the

2341
01:27:28,229 --> 01:27:26,960
enthusiasm each of you are showing

2342
01:27:30,390 --> 01:27:28,239
for your segments of the mission i can't

2343
01:27:33,590 --> 01:27:30,400
even imagine what this is like for you

2344
01:27:34,950 --> 01:27:33,600
my question is for mimi kim or amy um

2345
01:27:36,870 --> 01:27:34,960
you've developed some pretty interesting

2346
01:27:38,709 --> 01:27:36,880
new technology for ingenuity including

2347
01:27:39,590 --> 01:27:38,719
the high altitude flight the high rotor

2348
01:27:41,189 --> 01:27:39,600
speed

2349
01:27:43,590 --> 01:27:41,199
and the feature tracking camera for

2350
01:27:45,750 --> 01:27:43,600
navigation how do you anticipate this

2351
01:27:47,830 --> 01:27:45,760
technology might translate to advanced

2352
01:27:50,390 --> 01:27:47,840
air mobility or urban air mobility

2353
01:27:55,590 --> 01:27:50,400
flight that's currently being developed

2354
01:28:00,229 --> 01:27:59,350
sure well actually this is a great

2355
01:28:03,110 --> 01:28:00,239
question for

2356
01:28:04,390 --> 01:28:03,120
armd's uh revolutionary vertical lift

2357
01:28:06,550 --> 01:28:04,400
technology program

2358
01:28:07,990 --> 01:28:06,560
uh manager uh susan gordon of course

2359
01:28:10,790 --> 01:28:08,000
she's not here but um

2360
01:28:11,669 --> 01:28:10,800
armd uh really participated in the

2361
01:28:14,070 --> 01:28:11,679
fundamental

2362
01:28:14,709 --> 01:28:14,080
you know flying in a high altitude this

2363
01:28:16,629 --> 01:28:14,719

um

2364
01:28:17,910 --> 01:28:16,639
you know very very thin atmosphere and

2365
01:28:20,149 --> 01:28:17,920
uh increment and

2366
01:28:21,990 --> 01:28:20,159
and one of the overlap on earth would be

2367
01:28:23,189 --> 01:28:22,000
for a high altitude flight but i mean

2368
01:28:24,709 --> 01:28:23,199
susan would be able to

2369
01:28:26,709 --> 01:28:24,719
answer this question you know for

2370
01:28:28,950 --> 01:28:26,719
example flying

2371
01:28:30,229 --> 01:28:28,960
in himalayas right we can't we can't get

2372
01:28:33,430 --> 01:28:30,239
above uh certain

2373
01:28:37,030 --> 01:28:33,440
heights and so introducing this kind of

2374
01:28:39,830 --> 01:28:37,040
in a very thin uh you know high mark

2375
01:28:40,709 --> 01:28:39,840
number right operation in this very thin

2376
01:28:43,350 --> 01:28:40,719
atmosphere

2377
01:28:44,870 --> 01:28:43,360
that regime so it would be applicable to

2378
01:28:47,030 --> 01:28:44,880
very high altitude

2379
01:28:48,470 --> 01:28:47,040
applications uh that would be one

2380
01:28:50,070 --> 01:28:48,480
example uh but

2381
01:28:51,830 --> 01:28:50,080
really uh this is a great answer for

2382
01:28:53,430 --> 01:28:51,840
armd uh

2383
01:28:55,189 --> 01:28:53,440
yeah i think that they should really

2384
01:28:58,149 --> 01:28:55,199
answer that but i just want to tell you

2385
01:29:00,390 --> 01:28:58,159
uh i've been dreaming about a movie

2386
01:29:01,510 --> 01:29:00,400
taken of one of these amazingly high

2387
01:29:03,990 --> 01:29:01,520
mountains

2388
01:29:05,030 --> 01:29:04,000

that has been so many stories have been

2389
01:29:08,390 --> 01:29:05,040
about and actually

2390
01:29:09,189 --> 01:29:08,400
seeing that that kind of drone flying up

2391
01:29:10,950 --> 01:29:09,199
that cliff

2392
01:29:13,030 --> 01:29:10,960
you know i just i've been dreaming about

2393
01:29:15,110 --> 01:29:13,040
this and and uh and i'm sure there's

2394
01:29:17,189 --> 01:29:15,120
entrepreneurs innovators out there

2395
01:29:18,310 --> 01:29:17,199
who are thinking about this uh together

2396
01:29:19,430 --> 01:29:18,320
with of course the

2397
01:29:22,950 --> 01:29:19,440
work that we're doing within the

2398
01:29:25,910 --> 01:29:22,960
government you know once this test

2399
01:29:27,830 --> 01:29:25,920
you know hopefully is successful there

2400
01:29:28,310 --> 01:29:27,840
there are new applications that are

2401
01:29:31,110 --> 01:29:28,320
there

2402
01:29:33,189 --> 01:29:31,120
uh also here on earth applications that

2403
01:29:34,950 --> 01:29:33,199
we need to think of now applications

2404
01:29:38,950 --> 01:29:34,960
that nobody has really

2405
01:29:41,189 --> 01:29:38,960
made a reality as of yet

2406
01:29:41,990 --> 01:29:41,199
all right thank you so much for all your

2407
01:29:44,709 --> 01:29:42,000
questions

2408
01:29:46,390 --> 01:29:44,719
we unfortunately can't answer all the

2409
01:29:48,229 --> 01:29:46,400
media questions on air

2410
01:29:49,750 --> 01:29:48,239
for those of you with additional

2411
01:29:52,870 --> 01:29:49,760
questions please

2412
01:29:54,470 --> 01:29:52,880
call jpl's digital news and media office

2413
01:29:56,149 --> 01:29:54,480

we'll also continue to answer social

2414
01:29:58,310 --> 01:29:56,159
media questions online

2415
01:29:59,270 --> 01:29:58,320
and thank you all for all your questions

2416
01:30:01,350 --> 01:29:59,280
coming in and

2417
01:30:02,550 --> 01:30:01,360
thank you to our panelists for joining

2418
01:30:05,270 --> 01:30:02,560
us today

2419
01:30:06,629 --> 01:30:05,280
ingenuity will attempt its first powered

2420
01:30:09,590 --> 01:30:06,639
controlled flight

2421
01:30:11,669 --> 01:30:09,600
no earlier than april 11th if the

2422
01:30:13,510 --> 01:30:11,679
helicopter flies on april 11th

2423
01:30:14,950 --> 01:30:13,520
a live stream where you can watch

2424
01:30:17,430 --> 01:30:14,960
ingenuity engineers

2425
01:30:18,709 --> 01:30:17,440
analyze their first data from that test

2426
01:30:22,229 --> 01:30:18,719
flight it will begin

2427
01:30:25,270 --> 01:30:22,239
at 12 30 a.m pacific time

2428
01:30:27,189 --> 01:30:25,280
on april 12th an early morning there for

2429
01:30:31,110 --> 01:30:27,199
the latest helicopter schedule

2430
01:30:33,510 --> 01:30:31,120
visit go.nasa.gov ingenuity

2431
01:30:34,550 --> 01:30:33,520
there's a watch online section there

2432
01:30:37,110 --> 01:30:34,560
where you can get

2433
01:30:39,030 --> 01:30:37,120
broadcast updates and to learn more

2434
01:30:43,270 --> 01:30:39,040
about the perseverance rover

2435
01:30:45,030 --> 01:30:43,280
visit mars.nasa.gov perseverance

2436
01:30:47,110 --> 01:30:45,040
and like thomas and elsa mentioned

2437
01:30:48,390 --> 01:30:47,120
before for raw images from the

2438
01:30:51,510 --> 01:30:48,400

perseverance rover

2439
01:30:55,030 --> 01:30:51,520
visit go.nasa.gov

2440
01:30:58,149 --> 01:30:55,040
perseverance dash raw dash images

2441
01:30:59,510 --> 01:30:58,159
now the sheer volume of images coming

2442
01:31:01,910 --> 01:30:59,520
down after the first flight

2443
01:31:03,430 --> 01:31:01,920
it's going to take time to come through

2444
01:31:05,430 --> 01:31:03,440
to the public website

2445
01:31:06,709 --> 01:31:05,440
they will come down but we ask that you

2446
01:31:09,590 --> 01:31:06,719
be patient

2447
01:31:11,030 --> 01:31:09,600
as they load throughout the day and if

2448
01:31:12,629 --> 01:31:11,040
you're on social media

2449
01:31:14,790 --> 01:31:12,639
join the conversation about the

2450
01:31:17,990 --> 01:31:14,800
helicopter by following at

2451
01:31:19,750 --> 01:31:18,000
nasa jpl and use the hashtag mars