1
00:02:33,840 --> 00:01:24,560
[Music]

2
00:02:37,140 --> 00:02:35,760
all right welcome everyone so I were a

3
00:02:38,790 --> 00:02:37,150
few minutes late today technical

4
00:02:40,740 --> 00:02:38,800
challenges but we are here and excited

5
00:02:43,860 --> 00:02:40,750
we're talking again about the Mars 2020

6
00:02:46,470 --> 00:02:43,870
Rover and more specifically something

7
00:02:47,910 --> 00:02:46,480
that is the first of its kind I'm gonna

8
00:02:49,650 --> 00:02:47,920
jump in here right away and show you

9
00:02:51,270 --> 00:02:49,660
this as a little bit of a tease what

10
00:03:24,080 --> 00:02:51,280
we're talking about and what's to come

11
00:03:59,720 --> 00:03:33,090
[Music]

12
00:04:03,780 --> 00:04:02,160
that is correct for the first time ever

13
00:04:05,729 --> 00:04:03,790

we will be taking a helicopter to

14
00:04:07,530 --> 00:04:05,739
another planet super excited I'm your

15
00:04:09,839 --> 00:04:07,540
host today Joshua Santora coming to you

16
00:04:11,160 --> 00:04:09,849
from near the Kennedy Space Center I'm

17
00:04:13,020 --> 00:04:11,170
coming to you from my house

18
00:04:15,089 --> 00:04:13,030
we are excited today to welcome a couple

19
00:04:17,909 --> 00:04:15,099
guys out from the Jet Propulsion

20
00:04:20,009 --> 00:04:17,919
Laboratory but do want to highlight the

21
00:04:21,469 --> 00:04:20,019
fact that we are a spaceport open for

22
00:04:23,310 --> 00:04:21,479
business and active and ongoing

23
00:04:25,140 --> 00:04:23,320
specifically today we're talking about

24
00:04:26,520 --> 00:04:25,150
the launch services program or that's

25
00:04:28,950 --> 00:04:26,530
certainly the part of the Space Center

26
00:04:31,290 --> 00:04:28,960
that is active with Mars 2020 they are

27
00:04:32,999 --> 00:04:31,300
managing the launch for this rover so

28
00:04:34,980 --> 00:04:33,009
super excited for that excuse me of the

29
00:04:35,999 --> 00:04:34,990
rover and the helicopter so we're gonna

30
00:04:38,010 --> 00:04:36,009
go ahead and jump in now I'm gonna

31
00:04:42,089 --> 00:04:38,020
introduce my two guests here I have

32
00:04:44,159 --> 00:04:42,099
today håvard grip who is the flight

33
00:04:47,370 --> 00:04:44,169
control and aerodynamics lead and he

34
00:04:49,350 --> 00:04:47,380
also has the amazing task of being a

35
00:04:54,480 --> 00:04:49,360
helicopter pilot a Martian helicopter

36
00:04:55,770 --> 00:04:54,490
pilot Hobart thanks for being here well

37
00:04:59,219 --> 00:04:55,780
sorry I hope I'll try that one more time

38
00:05:00,750 --> 00:04:59,229

I had your mic and you did okay yeah

39
00:05:03,089 --> 00:05:00,760
just saying yeah it's good to be here

40
00:05:07,500 --> 00:05:03,099
yeah thank you so much and also today we

41
00:05:08,089 --> 00:05:07,510
have Josh Raymond Josh thanks for being

42
00:05:11,760 --> 00:05:08,099
here

43
00:05:14,640 --> 00:05:11,770
yeah absolutely so you are an ingenuity

44
00:05:16,830 --> 00:05:14,650
mechanical lead for this helicopter so

45
00:05:19,320 --> 00:05:16,840
let's jump right in here to some

46
00:05:21,029 --> 00:05:19,330
questions so thinking about this

47
00:05:23,550 --> 00:05:21,039
helicopter I want to know what

48
00:05:25,589 --> 00:05:23,560
specifically your roles are obviously

49
00:05:26,670 --> 00:05:25,599
this is something where you're kind of

50
00:05:28,290 --> 00:05:26,680
writing the book on this because

51
00:05:29,909 --> 00:05:28,300
nobody's done it before so I'll start

52
00:05:31,680 --> 00:05:29,919
with you Hubbard and then go to you Josh

53
00:05:35,120 --> 00:05:31,690
what's your role and what do you

54
00:05:39,000 --> 00:05:35,130
actively engage with on this helicopter

55
00:05:41,550 --> 00:05:39,010
yes since I started this project out in

56
00:05:43,260 --> 00:05:41,560
the Marshall copter lead for flight

57
00:05:46,860 --> 00:05:43,270
controller dynamics so that what that

58
00:05:49,439 --> 00:05:46,870
means is I led a team that's developed

59
00:05:51,810 --> 00:05:49,449
physical and mathematical models of the

60
00:05:54,210 --> 00:05:51,820
helicopter and then developed algorithms

61
00:05:56,129 --> 00:05:54,220
for navigating and controlling the

62
00:05:59,129 --> 00:05:56,139
helicopter and now that we're headed to

63
00:06:01,980 --> 00:05:59,139

Mars my role would be to basically

64
00:06:03,540 --> 00:06:01,990
operate operators algorithms by

65
00:06:06,420 --> 00:06:03,550
commanding it to do the things of the

66
00:06:12,800 --> 00:06:06,430
that we wanted to do and

67
00:06:16,500 --> 00:06:12,810
Rowlett na'ka'leen chief pilot and josh

68
00:06:19,470 --> 00:06:16,510
i'm the mechanical engineering lead so

69
00:06:21,810 --> 00:06:19,480
responsible for most of the the JPL

70
00:06:24,390 --> 00:06:21,820
designed hardware interfaces to all the

71
00:06:26,640 --> 00:06:24,400
other subsystems on the vehicle as well

72
00:06:29,130 --> 00:06:26,650
overseeing the actual build and assembly

73
00:06:33,030 --> 00:06:29,140
into a flight vehicle that were really

74
00:06:34,770 --> 00:06:33,040
involved in trying to turn a normal type

75
00:06:36,270 --> 00:06:34,780
of helicopter I mean there's not that

76
00:06:37,800 --> 00:06:36,280
much that's normal about this helicopter

77
00:06:40,170 --> 00:06:37,810
but you know what you think of as a

78
00:06:42,300 --> 00:06:40,180
helicopter package that for launch on a

79
00:06:44,850 --> 00:06:42,310
rocket and you know travel through space

80
00:06:47,220 --> 00:06:44,860
as well as just you know overseeing all

81
00:06:49,380 --> 00:06:47,230
the mechanical operations from you know

82
00:06:53,310 --> 00:06:49,390
from assembly through tests through

83
00:06:54,360 --> 00:06:53,320
integration into the river so sticking

84
00:06:55,800 --> 00:06:54,370
with you Josh thinking about the

85
00:06:58,500 --> 00:06:55,810
mechanical nature of this of the

86
00:07:00,030 --> 00:06:58,510
challenges that are here we probably

87
00:07:01,860 --> 00:07:00,040
would have tried this kind of an

88
00:07:03,570 --> 00:07:01,870

activity on the moon if it had an

89
00:07:05,760 --> 00:07:03,580
atmosphere but there's no atmosphere on

90
00:07:07,980 --> 00:07:05,770
the moon so a helicopter can't work Mars

91
00:07:10,350 --> 00:07:07,990
we do have a little atmosphere so what

92
00:07:12,420 --> 00:07:10,360
are the biggest challenges in trying to

93
00:07:15,810 --> 00:07:12,430
operate a helicopter on another planet

94
00:07:17,610 --> 00:07:15,820
specifically Mars well I mean I'm sure

95
00:07:20,310 --> 00:07:17,620
we could talk hours on the various

96
00:07:21,840 --> 00:07:20,320
challenges we had to overcome on this

97
00:07:24,000 --> 00:07:21,850
project but I think if you ask anybody

98
00:07:26,610 --> 00:07:24,010
the biggest challenge would be the mass

99
00:07:29,010 --> 00:07:26,620
as you mentioned atmosphere is extremely

100
00:07:31,950 --> 00:07:29,020
thin on Mars it's about 1% of the

101
00:07:33,480 --> 00:07:31,960
density on earth at sea level so it's

102
00:07:35,850 --> 00:07:33,490
about I think equivalent of around a

103
00:07:38,730 --> 00:07:35,860
hundred thousand feet on earth somewhere

104
00:07:41,730 --> 00:07:38,740
up in that range so mass keeping mass

105
00:07:44,520 --> 00:07:41,740
flow as low as possible to overcome the

106
00:07:46,650 --> 00:07:44,530
weight of the vehicle it's a huge huge

107
00:07:49,350 --> 00:07:46,660
challenge I had to do a lot of sort of

108
00:07:52,290 --> 00:07:49,360
non-standard approaches to you know get

109
00:07:55,080 --> 00:07:52,300
around that so there we've got a shot on

110
00:07:57,060 --> 00:07:55,090
screen of the helicopter itself so can

111
00:07:57,590 --> 00:07:57,070
you help me understand how big is this

112
00:08:00,000 --> 00:07:57,600
thing

113
00:08:02,400 --> 00:08:00,010

obviously we're probably not talking

114
00:08:05,720 --> 00:08:02,410
about a typical sized helicopter since

115
00:08:08,730 --> 00:08:05,730
we're flying all the way to Mars correct

116
00:08:11,070 --> 00:08:08,740
so actually the the blade wing spans a

117
00:08:13,010 --> 00:08:11,080
little bit over a meter so you know a

118
00:08:16,460 --> 00:08:13,020
little bit over three to four feet

119
00:08:20,500 --> 00:08:16,470
height is about half a meter tall and

120
00:08:24,160 --> 00:08:20,510
yeah mass is less than less than two

121
00:08:26,290 --> 00:08:24,170
it's a little less importance awesome

122
00:08:29,230 --> 00:08:26,300
very good håvard how do you how do you

123
00:08:31,480 --> 00:08:29,240
test this helicopter on earth because

124
00:08:33,100 --> 00:08:31,490
obviously if you're investing the time

125
00:08:35,170 --> 00:08:33,110
and energy to not only develop this but

126
00:08:38,500 --> 00:08:35,180
to also put it on a rocket and invest

127
00:08:40,210 --> 00:08:38,510
the extra fuel to get it to Mars how do

128
00:08:41,350 --> 00:08:40,220
you have that confidence through testing

129
00:08:44,890 --> 00:08:41,360
to know that it's gonna work on it when

130
00:08:46,720 --> 00:08:44,900
we get there so when it comes to testing

131
00:08:48,580 --> 00:08:46,730
Marcela copter nervous

132
00:08:51,040 --> 00:08:48,590
you have to do the fact that you can't

133
00:08:53,730 --> 00:08:51,050
replicate all aspects of Mars here on

134
00:08:56,290 --> 00:08:53,740
earth and certainly not at the same time

135
00:08:58,720 --> 00:08:56,300
so you have to take certain essential

136
00:09:00,670 --> 00:08:58,730
elements of the environment that you

137
00:09:03,150 --> 00:09:00,680
replicate in different tests for example

138
00:09:06,430 --> 00:09:03,160

the atmosphere radiation levels

139
00:09:09,490 --> 00:09:06,440
temperature visual surroundings etc and

140
00:09:11,940 --> 00:09:09,500
then you piece together the results from

141
00:09:14,560 --> 00:09:11,950
those tests to form a complete picture

142
00:09:16,510 --> 00:09:14,570
and one of the most important things for

143
00:09:19,660 --> 00:09:16,520
us is to see how the helicopter would

144
00:09:22,000 --> 00:09:19,670
behave in the low-density atmosphere on

145
00:09:24,220 --> 00:09:22,010
Mars and so for that we made extensive

146
00:09:28,120 --> 00:09:24,230
use of what we call a 25-foot space

147
00:09:30,040 --> 00:09:28,130
simulator at JPL and that's a big vacuum

148
00:09:32,890 --> 00:09:30,050
chamber where we have the ability to

149
00:09:34,390 --> 00:09:32,900
replicate the Martian atmosphere and so

150
00:09:36,130 --> 00:09:34,400
there we could perform various air

151
00:09:38,320 --> 00:09:36,140
dynamic tests and actually fly the

152
00:09:41,080 --> 00:09:38,330
vehicle as well and then there are

153
00:09:44,920 --> 00:09:41,090
certain things that we simply can't

154
00:09:46,840 --> 00:09:44,930
replicate on Paris at all and in

155
00:09:48,370 --> 00:09:46,850
particular that's the case with gravity

156
00:09:50,260 --> 00:09:48,380
we can't lower gravity here on the earth

157
00:09:52,840 --> 00:09:50,270
and so there are certain things we can

158
00:09:54,940 --> 00:09:52,850
do mechanically in order to try to

159
00:09:56,590 --> 00:09:54,950
approximate it in the video that you're

160
00:09:59,080 --> 00:09:56,600
just showing right now for example as a

161
00:10:01,150 --> 00:09:59,090
tests flight where we're offloading part

162
00:10:03,730 --> 00:10:01,160
of the gravity with a tether in order to

163
00:10:05,980 --> 00:10:03,740

help it also the park you know the

164
00:10:08,380 --> 00:10:05,990
difference between earth gravity and

165
00:10:10,120 --> 00:10:08,390
Mars gravity but ultimately because we

166
00:10:12,400 --> 00:10:10,130
can't replicate it fully but then also

167
00:10:14,110 --> 00:10:12,410
have to rely on computer simulations in

168
00:10:16,510 --> 00:10:14,120
order to under this understand the

169
00:10:17,860 --> 00:10:16,520
effect to that so one of the questions

170
00:10:19,510 --> 00:10:17,870
that's already come in and feel free to

171
00:10:21,850 --> 00:10:19,520
ask questions in the chat box there as

172
00:10:24,910 --> 00:10:21,860
we go through the show today was how do

173
00:10:27,340 --> 00:10:24,920
you protect the the mechanical elements

174
00:10:28,780 --> 00:10:27,350
the expose elements from dust particles

175
00:10:32,290 --> 00:10:28,790
and other things that could potentially

176
00:10:34,790 --> 00:10:32,300
harm the actual vehicle

177
00:10:38,000 --> 00:10:34,800
did you want me to take this one hard

178
00:10:41,360 --> 00:10:38,010
yeah please so on the on the rover

179
00:10:42,830 --> 00:10:41,370
itself there's actually debris shield so

180
00:10:45,080 --> 00:10:42,840
as we land we're on the belly of the

181
00:10:46,430 --> 00:10:45,090
rover so as we're coming down you know

182
00:10:48,830 --> 00:10:46,440
it's kicking up dust kicking up rocks

183
00:10:51,080 --> 00:10:48,840
even once on the surface driving around

184
00:10:53,000 --> 00:10:51,090
they're just you know certainly rocks so

185
00:10:55,430 --> 00:10:53,010
we have actually quite a big debris

186
00:10:57,080 --> 00:10:55,440
shield to protect us yeah you can see

187
00:10:59,660 --> 00:10:57,090
kind of in purple in the in the picture

188
00:11:02,150 --> 00:10:59,670

there once we once we're deployed we

189
00:11:04,310 --> 00:11:02,160
actually did a lot of you know looking

190
00:11:06,800 --> 00:11:04,320
into you know what the dusts would be we

191
00:11:08,720 --> 00:11:06,810
don't think the dust will be so bad so

192
00:11:10,520 --> 00:11:08,730
there's a little bit you know a little

193
00:11:12,260 --> 00:11:10,530
bit of effort into you know how to keep

194
00:11:13,730 --> 00:11:12,270
dust out of the mechanisms but for the

195
00:11:15,350 --> 00:11:13,740
most part we've done a lot of efforts

196
00:11:17,030 --> 00:11:15,360
and found that you know we don't expect

197
00:11:18,320 --> 00:11:17,040
it to be as big of a problem as you'd

198
00:11:21,830 --> 00:11:18,330
imagine flying around the deserts on

199
00:11:23,420 --> 00:11:21,840
earth okay awesome so we kind of alluded

200
00:11:25,310 --> 00:11:23,430
to the fact or we're specific with the

201
00:11:28,430 --> 00:11:25,320
fact that you're launching on the belly

202
00:11:30,620 --> 00:11:28,440
of the rover so Hobart can you talk a

203
00:11:32,930 --> 00:11:30,630
little bit about what's the process once

204
00:11:36,620 --> 00:11:32,940
we have successful touchdown which we're

205
00:11:37,430 --> 00:11:36,630
targeting for February of 2021 so what

206
00:11:39,320 --> 00:11:37,440
happens after that

207
00:11:40,760 --> 00:11:39,330
are we deploying day one is it we're

208
00:11:42,410 --> 00:11:40,770
waiting a while what's what are the

209
00:11:46,010 --> 00:11:42,420
criteria to kind of move us forward in

210
00:11:47,900 --> 00:11:46,020
the timeline so yeah we deploy

211
00:11:49,910 --> 00:11:47,910
immediately after landing there are

212
00:11:51,710 --> 00:11:49,920
certain commissioning aspects of the

213
00:11:55,730 --> 00:11:51,720

rover itself that has to happen first

214
00:11:57,500 --> 00:11:55,740
and then we will start driving and then

215
00:12:00,710 --> 00:11:57,510
looking for a place to drop off the

216
00:12:02,480 --> 00:12:00,720
helicopter and so when we're looking for

217
00:12:05,330 --> 00:12:02,490
a drop-off spot for the I look after

218
00:12:08,660 --> 00:12:05,340
things that we're interested in or that

219
00:12:11,750 --> 00:12:08,670
we need to to find is an area where we

220
00:12:13,850 --> 00:12:11,760
can operate not of not only to take off

221
00:12:16,940 --> 00:12:13,860
but also to fly in the vicinity of that

222
00:12:18,920 --> 00:12:16,950
area and then come back and land in that

223
00:12:22,340 --> 00:12:18,930
area again so specifically for that

224
00:12:24,680 --> 00:12:22,350
we're looking for slopes of the terrain

225
00:12:26,180 --> 00:12:24,690
if you have to highest slope it could be

226
00:12:27,770 --> 00:12:26,190
a problem but for takeoff and landing

227
00:12:30,470 --> 00:12:27,780
for the helicopter so left at moderate

228
00:12:32,000 --> 00:12:30,480
slopes we're looking for rocks that

229
00:12:34,100 --> 00:12:32,010
could be potential obstacles especially

230
00:12:37,010 --> 00:12:34,110
I'm landing and then we're looking for

231
00:12:38,870 --> 00:12:37,020
features in the terrain one of the

232
00:12:41,300 --> 00:12:38,880
things about the helicopter is we have

233
00:12:42,500 --> 00:12:41,310
to navigate you know the hell

234
00:12:44,500 --> 00:12:42,510
compressing know where it is at any

235
00:12:45,710 --> 00:12:44,510
point in time and we don't have GPS on

236
00:12:48,619 --> 00:12:45,720
Mars

237
00:12:50,990 --> 00:12:48,629
and so instead we use a camera to look

238
00:12:54,319 --> 00:12:51,000

at the terrain below the helicopter and

239
00:12:56,900 --> 00:12:54,329
track features in the terrain and in

240
00:12:59,509 --> 00:12:56,910
order to do that there have be features

241
00:13:01,490 --> 00:12:59,519
that we can hang on to and so we have to

242
00:13:03,530 --> 00:13:01,500
make sure when we pick a drop-off spot

243
00:13:04,879 --> 00:13:03,540
that the surrounding terrain is not so

244
00:13:10,309 --> 00:13:04,889
bland that there aren't any features

245
00:13:11,840 --> 00:13:10,319
that we get that we can track and Josh

246
00:13:13,850 --> 00:13:11,850
can you talk about what the power is

247
00:13:15,230 --> 00:13:13,860
like for this vehicle obviously you have

248
00:13:17,269 --> 00:13:15,240
to have a power so we're somewhere I

249
00:13:20,150 --> 00:13:17,279
think most commonly we see solar power

250
00:13:22,160 --> 00:13:20,160
or just batteries so what are we

251
00:13:25,280 --> 00:13:22,170
expecting for or what what is in store

252
00:13:27,319 --> 00:13:25,290
for ingenuity a name recently given to

253
00:13:28,879 --> 00:13:27,329
the helicopter again I think a student

254
00:13:33,530 --> 00:13:28,889
from Alabama naming this one which is

255
00:13:35,449 --> 00:13:33,540
pretty cool yes actually we have both of

256
00:13:38,119 --> 00:13:35,459
what you mentioned we have stolen panels

257
00:13:40,490 --> 00:13:38,129
and batteries so helicopter you know sit

258
00:13:43,160 --> 00:13:40,500
around charge up you know might take

259
00:13:45,470 --> 00:13:43,170
about it you know a day charges up its

260
00:13:47,449 --> 00:13:45,480
batteries and then it'll go through its

261
00:13:49,189 --> 00:13:47,459
flight actually a lot of the battery

262
00:13:51,139 --> 00:13:49,199
power goes into other things like

263
00:13:54,949 --> 00:13:51,149

surviving the Martian night which is

264
00:13:56,569 --> 00:13:54,959
quite harsh but yeah and about it you

265
00:14:00,319 --> 00:13:56,579
know about a day you know works out

266
00:14:03,889 --> 00:14:00,329
pretty well to operate the mission and

267
00:14:05,720 --> 00:14:03,899
Hobart can you speak to why there's no

268
00:14:08,449 --> 00:14:05,730
science onboard I understand that there

269
00:14:11,090 --> 00:14:08,459
there's no scientific instruments per se

270
00:14:13,400 --> 00:14:11,100
onboard the helicopter so why is that

271
00:14:15,049 --> 00:14:13,410
and so what are what are we really

272
00:14:16,939 --> 00:14:15,059
hoping to gain what's the value in the

273
00:14:20,569 --> 00:14:16,949
benefit of this this part of the mission

274
00:14:23,780 --> 00:14:20,579
the reason we don't have science

275
00:14:25,660 --> 00:14:23,790
instruments onboard is that ingenuity is

276
00:14:28,400 --> 00:14:25,670
what because technology demonstration

277
00:14:30,679 --> 00:14:28,410
where the end goal is to perform a set

278
00:14:32,660 --> 00:14:30,689
of experimental test flights in order to

279
00:14:34,220 --> 00:14:32,670
show that it's possible to fly a

280
00:14:36,590 --> 00:14:34,230
helicopter Mars and to lay the

281
00:14:38,059 --> 00:14:36,600
groundwork for future missions you can

282
00:14:40,160 --> 00:14:38,069
compare it to how the Wright brothers

283
00:14:42,619 --> 00:14:40,170
demonstrated the feasibility of powered

284
00:14:44,749 --> 00:14:42,629
flight did an experimental test flight

285
00:14:46,509 --> 00:14:44,759
once we proven out the technology that

286
00:14:49,670 --> 00:14:46,519
lays the groundwork for future missions

287
00:14:52,069 --> 00:14:49,680
can use helicopters in in useful roles

288
00:14:56,220 --> 00:14:52,079

and that includes carrying their own

289
00:15:02,100 --> 00:15:00,390
and Josh can you speak to the the nature

290
00:15:03,810 --> 00:15:02,110
of kind of and I'm going to try to faint

291
00:15:08,250 --> 00:15:03,820
phrase this question but kind of how we

292
00:15:11,190 --> 00:15:08,260
got to this point did you have to have

293
00:15:12,840 --> 00:15:11,200
special accommodations to have those the

294
00:15:14,880 --> 00:15:12,850
shields for the helicopter and how to

295
00:15:16,560 --> 00:15:14,890
actually like mount it successfully to

296
00:15:19,260 --> 00:15:16,570
the bottom of a rover like what's kind

297
00:15:21,210 --> 00:15:19,270
of gone into that that process to be

298
00:15:24,110 --> 00:15:21,220
ready to have this thing in place and

299
00:15:27,360 --> 00:15:24,120
and useful when we get to Mars

300
00:15:29,790 --> 00:15:27,370
absolutely so as I might have referenced

301
00:15:32,010 --> 00:15:29,800
earlier you know it's not just a normal

302
00:15:33,300 --> 00:15:32,020
I mean again not a normal helicopter

303
00:15:34,530 --> 00:15:33,310
mission but even amongst the helicopter

304
00:15:37,770 --> 00:15:34,540
mission this is also a space launch

305
00:15:39,780 --> 00:15:37,780
mission so trying to package a

306
00:15:41,640 --> 00:15:39,790
helicopter to launch on a rocket it was

307
00:15:46,380 --> 00:15:41,650
a quite a challenge and everyone from

308
00:15:48,330 --> 00:15:46,390
the 2020 project the rover team as well

309
00:15:49,890 --> 00:15:48,340
as the helicopter team spent a long time

310
00:15:51,720 --> 00:15:49,900
working out the engineering how to

311
00:15:53,100 --> 00:15:51,730
support the helicopter properly asking

312
00:15:56,070 --> 00:15:53,110
how do you hold it how do you connect

313
00:15:58,830 --> 00:15:56,080

the blades I protect the legs how do you

314
00:16:00,750 --> 00:15:58,840
pass communication signals from the

315
00:16:03,270 --> 00:16:00,760
rover into the helicopter and back out

316
00:16:05,130 --> 00:16:03,280
again so everybody really good you know

317
00:16:06,930 --> 00:16:05,140
a great job worked really hard on both

318
00:16:08,610 --> 00:16:06,940
sides of you know the team's the rover

319
00:16:10,710 --> 00:16:08,620
team helicopter team and we're just

320
00:16:12,090 --> 00:16:10,720
grateful that you know we all work

321
00:16:15,810 --> 00:16:12,100
together so well and came up with such a

322
00:16:18,390 --> 00:16:15,820
you know such a good design yeah awesome

323
00:16:20,280 --> 00:16:18,400
obviously it is super exciting thinking

324
00:16:22,290 --> 00:16:20,290
about the future where are you guys

325
00:16:25,050 --> 00:16:22,300
planning to be for for launch and

326
00:16:26,970 --> 00:16:25,060
landing of the perseverance mission

327
00:16:29,370 --> 00:16:26,980
obviously for the helicopter portions

328
00:16:30,810 --> 00:16:29,380
you have a ways after landing to go but

329
00:16:38,160 --> 00:16:30,820
kind of leading up to that how are you

330
00:16:41,340 --> 00:16:38,170
guys engaged I'm hoping personally to to

331
00:16:47,550 --> 00:16:41,350
be able to witness the launch that's

332
00:16:50,040 --> 00:16:47,560
that's that's my hope yeah me too cool

333
00:16:51,660 --> 00:16:50,050
finally be in Florida for landing you

334
00:16:53,850 --> 00:16:51,670
know sure we'll be watching on TV like

335
00:16:55,950 --> 00:16:53,860
everybody else you know expectantly

336
00:16:57,930 --> 00:16:55,960
waiting awesome good well gentlemen

337
00:16:59,760 --> 00:16:57,940
appreciate your time today thank you for

338
00:17:01,290 --> 00:16:59,770

this obviously like we're all gonna be

339
00:17:04,800 --> 00:17:01,300
super excited anytime we do something

340
00:17:06,930 --> 00:17:04,810
that is undeniably innovative it gathers

341
00:17:09,040 --> 00:17:06,940
people's attention so I'm personally

342
00:17:10,750 --> 00:17:09,050
super excited to see this thing

343
00:17:12,250 --> 00:17:10,760
I'm assuming and this is something we

344
00:17:13,510 --> 00:17:12,260
haven't really talked about art are we

345
00:17:15,340 --> 00:17:13,520
gonna have cameras on board to be able

346
00:17:19,390 --> 00:17:15,350
to get footage back from flying around

347
00:17:21,160 --> 00:17:19,400
Mars we do have cameras on board there

348
00:17:22,689 --> 00:17:21,170
two cameras there's a downward looking

349
00:17:24,549 --> 00:17:22,699
camera that we used for navigation that

350
00:17:25,960 --> 00:17:24,559
I mentioned before and there's also what

351
00:17:28,240 --> 00:17:25,970
we call the return to Earth camera which

352
00:17:29,770 --> 00:17:28,250
is a higher resolution color camera

353
00:17:32,169 --> 00:17:29,780
that's out there looking and we do have

354
00:17:35,110 --> 00:17:32,179
the ability to take pictures and some of

355
00:17:37,930 --> 00:17:35,120
them will be downlinking so that we can

356
00:17:40,120 --> 00:17:37,940
see that here on earth awesome very cool

357
00:17:41,740 --> 00:17:40,130
Hobart Josh thank you so much good luck

358
00:17:44,500 --> 00:17:41,750
I know that there's still probably some

359
00:17:45,790 --> 00:17:44,510
work to do and a lot of waiting but wish

360
00:17:50,500 --> 00:17:45,800
you the best and thanks for joining us

361
00:17:52,419 --> 00:17:50,510
today absolutely thank you so much all

362
00:17:54,310 --> 00:17:52,429
right so before we let you go for today

363
00:17:56,230 --> 00:17:54,320

I want to be able to highlight a couple

364
00:17:59,049 --> 00:17:56,240
more things going on

365
00:18:01,270 --> 00:17:59,059
specifically I want to as have been in

366
00:18:03,610 --> 00:18:01,280
the habit recently sharing some NASA at

367
00:18:05,320 --> 00:18:03,620
home stuff our show here is definitely

368
00:18:07,150 --> 00:18:05,330
part of something bigger than just us

369
00:18:09,310 --> 00:18:07,160
the NASA at home effort is really broad

370
00:18:11,230 --> 00:18:09,320
and expansive specifically we want to

371
00:18:13,630 --> 00:18:11,240
highlight some things for you today this

372
00:18:15,549 --> 00:18:13,640
one just the apps available there are so

373
00:18:17,470 --> 00:18:15,559
many really cool NASA apps everything

374
00:18:19,770 --> 00:18:17,480
from artistic related things to virtual

375
00:18:22,810 --> 00:18:19,780
reality augmented reality great videos

376
00:18:24,730 --> 00:18:22,820
great content from space station and on

377
00:18:26,110 --> 00:18:24,740
earth and exploring Earth and

378
00:18:27,910 --> 00:18:26,120
understanding earth so please be sure to

379
00:18:29,950 --> 00:18:27,920
check those things out those are

380
00:18:31,510 --> 00:18:29,960
phenomenal also want to highlight a few

381
00:18:35,230 --> 00:18:31,520
things for you that happened this week

382
00:18:37,360 --> 00:18:35,240
in social media it has been a big week

383
00:18:40,660 --> 00:18:37,370
for social media things happening and

384
00:18:42,790 --> 00:18:40,670
definitely a lot coming up with

385
00:18:44,590 --> 00:18:42,800
Commercial Crew kicking off specifically

386
00:18:45,610 --> 00:18:44,600
we want to point to an announcement I

387
00:18:47,470 --> 00:18:45,620
mentioned this at the end of the last

388
00:18:49,390 --> 00:18:47,480

show the human Lander system

389
00:18:54,400 --> 00:18:49,400
announcement we announced three

390
00:18:56,320 --> 00:18:54,410
recipients of a very big award as part

391
00:18:58,299 --> 00:18:56,330
of this grant or a part of this research

392
00:18:59,980 --> 00:18:58,309
proposal or demonstration proposal

393
00:19:01,600 --> 00:18:59,990
forgive me and those specific words are

394
00:19:03,490 --> 00:19:01,610
probably not the right ones I'm not the

395
00:19:05,530 --> 00:19:03,500
guy in charge of this program but Blue

396
00:19:07,990 --> 00:19:05,540
Origin Dianetics and SpaceX

397
00:19:09,490 --> 00:19:08,000
all received awards so super excited for

398
00:19:10,960 --> 00:19:09,500
what's coming that is pointing to us

399
00:19:14,020 --> 00:19:10,970
having Landers for the our tennis

400
00:19:15,910 --> 00:19:14,030
program for sustained presence on the

401
00:19:18,580 --> 00:19:15,920
moon not just a return but sustained

402
00:19:19,870 --> 00:19:18,590
presence also this I don't know what

403
00:19:22,080 --> 00:19:19,880
this means exactly but it's super

404
00:19:23,940 --> 00:19:22,090
exciting and it's fresh

405
00:19:26,039 --> 00:19:23,950
apparently Tom Cruise is working on a

406
00:19:27,330 --> 00:19:26,049
movie on Space Station this is a tweet

407
00:19:29,310 --> 00:19:27,340
from our administrator talking about

408
00:19:30,960 --> 00:19:29,320
this so I'm sure there's more details to

409
00:19:33,210 --> 00:19:30,970
come keep your eyes peeled for that it

410
00:19:35,820 --> 00:19:33,220
should be exciting whatever it is and

411
00:19:37,769 --> 00:19:35,830
then definitely be tuning in track NASA

412
00:19:39,090 --> 00:19:37,779
Commercial Crew we're within 30 days now

413
00:19:41,130 --> 00:19:39,100

which means there is there are things

414
00:19:43,250 --> 00:19:41,140
happening all the time getting the crew

415
00:19:45,299 --> 00:19:43,260
and the rocket and the spacecraft ready

416
00:19:47,220 --> 00:19:45,309
certainly within the last week there's

417
00:19:49,320 --> 00:19:47,230
gonna be a ton but follow NASA

418
00:19:51,360 --> 00:19:49,330
Commercial Crew Twitter and you can stay

419
00:19:53,370 --> 00:19:51,370
in touch with all of that and that's

420
00:19:56,460 --> 00:19:53,380
gonna do it for me today here from the

421
00:19:57,840 --> 00:19:56,470
Kennedy Space Center sort of but I just

422
00:19:59,460 --> 00:19:57,850
want to remind you that even the sky