Coming up

Perseverance's Landiversary:

CELEBRATING A YEAR OF EXPLORATION WITH NASA'S MARS ROVER

Friday, February 18 at 1 p.m. PST, 4 p.m. EST

1
00:00:42,610 --> 00:00:01,130
[Music]

2
00:00:51,970 --> 00:00:44,520
thank you

3
00:00:51,980 --> 00:01:06,469
[Music]

4
00:01:06,479 --> 00:01:09,940
foreign

5
00:01:52,730 --> 00:01:36,550
[Music]

6
00:02:30,340 --> 00:01:52,740
foreign

7
00:03:09,290 --> 00:02:35,270
[Music]

8
00:03:09,300 --> 00:03:17,080
foreign

9
00:03:39,410 --> 00:03:28,360
[Music]

10
00:03:39,420 --> 00:03:45,120
foreign

11
00:04:44,020 --> 00:03:52,030
[Music]

12
00:05:16,170 --> 00:04:44,030
foreign

13
00:05:16,180 --> 00:05:28,430

[Music]

14
00:05:28,440 --> 00:05:32,350
foreign

15
00:05:32,360 --> 00:05:57,050
[Music]

16
00:05:57,060 --> 00:06:12,640
foreign

17
00:06:44,650 --> 00:06:22,370
[Music]

18
00:06:44,660 --> 00:06:48,490
thank you

19
00:07:06,230 --> 00:06:56,690
[Music]

20
00:07:16,430 --> 00:07:07,980
foreign

21
00:07:40,189 --> 00:07:24,700
[Music]

22
00:07:40,199 --> 00:07:43,940
foreign

23
00:08:30,290 --> 00:07:55,460
[Music]

24
00:08:35,389 --> 00:08:32,509
welcome to NASA's jet propulsion

25
00:08:37,610 --> 00:08:35,399
laboratory in Southern California today

26
00:08:39,829 --> 00:08:37,620
we are celebrating the one year

27
00:08:42,769 --> 00:08:39,839
anniversary of the perseverance Rover

28
00:08:45,230 --> 00:08:42,779
safely landing on the surface of Mars

29
00:08:48,110 --> 00:08:45,240
now we are in an area of the lab called

30
00:08:50,990 --> 00:08:48,120
the Mars yard which is a simulated

31
00:08:53,750 --> 00:08:51,000
Martian environment where tests are done

32
00:08:56,949 --> 00:08:53,760
and we have a couple special guests

33
00:09:00,829 --> 00:08:56,959
joining us today we have swathi mohand

34
00:09:03,530 --> 00:09:00,839
and Rachel croniak who are part of the

35
00:09:05,810 --> 00:09:03,540
perseverance Mission now swathi you

36
00:09:09,170 --> 00:09:05,820
might remember her as the commentator

37
00:09:10,670 --> 00:09:09,180
who announced that the Rover safely

38
00:09:12,949 --> 00:09:10,680

touched down on the surface of Mars

39
00:09:14,990 --> 00:09:12,959
while being admission control and Rachel

40
00:09:17,329 --> 00:09:15,000
is currently working on the science

41
00:09:19,250 --> 00:09:17,339
operation side of things now they will

42
00:09:21,530 --> 00:09:19,260
be answering any questions you might

43
00:09:25,550 --> 00:09:21,540
have if you would like to ask a question

44
00:09:27,710 --> 00:09:25,560
use the ask NASA hashtag or leave your

45
00:09:29,690 --> 00:09:27,720
comments in the chat that box now to get

46
00:09:33,410 --> 00:09:29,700
started I have a couple questions for

47
00:09:37,490 --> 00:09:33,420
you swathi oh can you believe it's been

48
00:09:38,630 --> 00:09:37,500
a year I can't it's gone by so fast I

49
00:09:42,910 --> 00:09:38,640
can't believe it's been a year already

50
00:09:45,769 --> 00:09:42,920
since Landing day and around this time

51
00:09:48,590 --> 00:09:45,779
last year you were in Mission Control

52
00:09:50,829 --> 00:09:48,600
what was that like yeah leading up to

53
00:09:53,389 --> 00:09:50,839
The Landing that week before we were all

54
00:09:56,269 --> 00:09:53,399
super stressed and worried making sure

55
00:09:58,130 --> 00:09:56,279
everything was going right there's so

56
00:10:01,550 --> 00:09:58,140
many different pieces to Landing that

57
00:10:04,009 --> 00:10:01,560
have to go perfectly in order to reach

58
00:10:05,930 --> 00:10:04,019
the ground safely you know we had our

59
00:10:08,990 --> 00:10:05,940
share of hard stopping moments during

60
00:10:11,329 --> 00:10:09,000
the entry to tent Landing but to be able

61
00:10:13,850 --> 00:10:11,339
to confirm that we were on the surface

62
00:10:17,030 --> 00:10:13,860
safely to get that first image back from

63
00:10:18,610 --> 00:10:17,040

Mars was just an incredible relief and

64
00:10:21,170 --> 00:10:18,620
an amazing feeling for the whole team

65
00:10:23,750 --> 00:10:21,180
and you were on the engineering side of

66
00:10:26,269 --> 00:10:23,760
things now Rachel as part of the science

67
00:10:28,490 --> 00:10:26,279
operations team what are you and the

68
00:10:29,930 --> 00:10:28,500
mission up to now yeah so like Raquel

69
00:10:32,690 --> 00:10:29,940
mentioned I'm on the science operations

70
00:10:34,190 --> 00:10:32,700
team so I get to help bill the plans of

71
00:10:36,769 --> 00:10:34,200
activities that we send up to the Rover

72
00:10:38,389 --> 00:10:36,779
every single day and a year ago we

73
00:10:40,310 --> 00:10:38,399
landed in a place called Jezreel crater

74
00:10:42,230 --> 00:10:40,320
which is home to an ancient river Delta

75
00:10:44,030 --> 00:10:42,240
which we think is a really good place to

76
00:10:45,889 --> 00:10:44,040
look for signs of ancient Life on Mars

77
00:10:48,230 --> 00:10:45,899
now we ended up Landing a couple of

78
00:10:49,850 --> 00:10:48,240
kilometers to the east of the Delta and

79
00:10:51,470 --> 00:10:49,860
so for the past year we've been spending

80
00:10:53,750 --> 00:10:51,480
our time exploring the rocks that make

81
00:10:55,190 --> 00:10:53,760
up the crater floor and once we wrap up

82
00:10:56,630 --> 00:10:55,200
our crater floor activities we're going

83
00:10:58,190 --> 00:10:56,640
to be making a beeline to the Delta

84
00:11:00,650 --> 00:10:58,200
which is going to be the next location

85
00:11:02,210 --> 00:11:00,660
for our next science campaign and as you

86
00:11:05,569 --> 00:11:02,220
can hear it's kind of busy here in the

87
00:11:07,910 --> 00:11:05,579
Mars yard today can you explain why this

88
00:11:09,889 --> 00:11:07,920

area is important for Rover operations

89
00:11:11,870 --> 00:11:09,899
yeah so the Mars yard is a really

90
00:11:14,090 --> 00:11:11,880
special place for us to test and

91
00:11:16,009 --> 00:11:14,100
practice all sorts of things with our

92
00:11:18,110 --> 00:11:16,019
earth-based version of perseverance

93
00:11:20,090 --> 00:11:18,120
named optimism before we do them for

94
00:11:22,430 --> 00:11:20,100
real on Mars and if there's anything

95
00:11:24,350 --> 00:11:22,440
that we know for certain about Mars is

96
00:11:26,569 --> 00:11:24,360
that Mars is oftentimes unpredictable

97
00:11:28,670 --> 00:11:26,579
and so the Mars art is a really special

98
00:11:30,470 --> 00:11:28,680
asset for us to be able to troubleshoot

99
00:11:33,949 --> 00:11:30,480
when we encounter unexpected things on

100
00:11:36,170 --> 00:11:33,959
Mars and what is your favorite memory of

101
00:11:37,490 --> 00:11:36,180
the perseverance Mission so far gosh

102
00:11:39,829 --> 00:11:37,500
it's so hard to pick just one because

103
00:11:41,509 --> 00:11:39,839
it's been a really exciting year a

104
00:11:43,370 --> 00:11:41,519
memory that sticks out for me was a

105
00:11:44,810 --> 00:11:43,380
couple of months after landing when we

106
00:11:46,970 --> 00:11:44,820
were getting ready to send up our first

107
00:11:49,370 --> 00:11:46,980
activity plan telling perseverance to

108
00:11:50,569 --> 00:11:49,380
collect our first rock sample so this

109
00:11:52,550 --> 00:11:50,579
was something that we were working on

110
00:11:54,889 --> 00:11:52,560
for weeks and months leading up to that

111
00:11:56,690 --> 00:11:54,899
day so when the day was finally here it

112
00:11:58,550 --> 00:11:56,700
was super exciting it was also very

113
00:12:00,050 --> 00:11:58,560

nerve-wracking and like Swati said about

114
00:12:02,629 --> 00:12:00,060
Landing it was a huge relief once we

115
00:12:05,150 --> 00:12:02,639
were able to do it sure what about you

116
00:12:07,790 --> 00:12:05,160
swathi I Echo Rachel and that it's

117
00:12:09,590 --> 00:12:07,800
really hard to pick just one but I would

118
00:12:12,769 --> 00:12:09,600
have to say it's pretty hard to beat

119
00:12:14,870 --> 00:12:12,779
Landing day it was the culmination of

120
00:12:17,810 --> 00:12:14,880
all of the work that we had done for so

121
00:12:19,790 --> 00:12:17,820
many years you know the the hard nights

122
00:12:21,170 --> 00:12:19,800
and the long nights and the the testing

123
00:12:23,210 --> 00:12:21,180
and the good things and the bad things

124
00:12:24,769 --> 00:12:23,220
kind of coming together with all the

125
00:12:27,110 --> 00:12:24,779
memories associated with that for that

126
00:12:29,449 --> 00:12:27,120
successful day that kind of encapsulates

127
00:12:32,210 --> 00:12:29,459
the the whole mission for me and after

128
00:12:34,310 --> 00:12:32,220
that what did you do next so Rachel

129
00:12:36,230 --> 00:12:34,320
mentioned the first sample acquisition

130
00:12:38,569 --> 00:12:36,240
on Mars that's really important actually

131
00:12:40,850 --> 00:12:38,579
because perseverance was the first leg

132
00:12:43,970 --> 00:12:40,860
of Mars sample return so the fact that

133
00:12:46,670 --> 00:12:43,980
we confirmed that we got one sample

134
00:12:48,949 --> 00:12:46,680
successfully kind of kicked off a

135
00:12:51,530 --> 00:12:48,959
multi-agency effort to bring those

136
00:12:54,889 --> 00:12:51,540
samples back to Earth I'm working on one

137
00:12:57,050 --> 00:12:54,899
part of that Campaign which is a Lander

138
00:12:59,509 --> 00:12:57,060

that will go to Mars with a rocket on it

139
00:13:02,269 --> 00:12:59,519
that is intended to get the samples off

140
00:13:05,509 --> 00:13:02,279
the surface of Mars into space

141
00:13:08,629 --> 00:13:05,519
now after you wrapped up the mission is

142
00:13:10,069 --> 00:13:08,639
that typical for an employee of JPL to

143
00:13:12,230 --> 00:13:10,079
start on a new mission

144
00:13:14,810 --> 00:13:12,240
it is actually when we wrap up one

145
00:13:16,970 --> 00:13:14,820
Mission we often go to the next one that

146
00:13:18,769 --> 00:13:16,980
needs to help so the Mars 2020

147
00:13:21,769 --> 00:13:18,779
perseverance team actually went to

148
00:13:24,889 --> 00:13:21,779
multiple different missions

149
00:13:27,470 --> 00:13:24,899
they went to psyche which is next up in

150
00:13:29,389 --> 00:13:27,480
launch this year to Europa Clipper which

151
00:13:31,190 --> 00:13:29,399
is next about a few years from now and

152
00:13:33,050 --> 00:13:31,200
then also to the sample retrieval Lander

153
00:13:34,910 --> 00:13:33,060
which has a little bit longer one way

154
00:13:38,030 --> 00:13:34,920
until it launches

155
00:13:40,430 --> 00:13:38,040
uh as you can tell it's really really

156
00:13:42,650 --> 00:13:40,440
noisy here today but we're gonna see

157
00:13:43,910 --> 00:13:42,660
some familiar faces as Swati mentioned

158
00:13:45,650 --> 00:13:43,920
and we're going to get to some viewer

159
00:13:48,650 --> 00:13:45,660
questions now so if you have a question

160
00:13:50,810 --> 00:13:48,660
you'd like to ask please use the ask

161
00:13:54,350 --> 00:13:50,820
NASA hashtag or leave your comments in

162
00:13:57,410 --> 00:13:54,360
the chat box so first up prevents on

163
00:14:00,050 --> 00:13:57,420

Instagram asks how long did it take to

164
00:14:02,870 --> 00:14:00,060
complete the Rovers construction saki do

165
00:14:04,850 --> 00:14:02,880
you want to take that one sure so Mars

166
00:14:09,230 --> 00:14:04,860
2020 as a project started very soon

167
00:14:11,750 --> 00:14:09,240
after curiosity landed around 2011 2012.

168
00:14:13,250 --> 00:14:11,760
that's when the design work started for

169
00:14:15,650 --> 00:14:13,260
the mission in general the Rover

170
00:14:17,269 --> 00:14:15,660
construction for the actual Hardware

171
00:14:19,009 --> 00:14:17,279
that would be sent to Mars started a

172
00:14:21,710 --> 00:14:19,019
little bit later than that around the

173
00:14:24,230 --> 00:14:21,720
2018 time frame to get ready for a

174
00:14:27,769 --> 00:14:24,240
launch in 2020. and I have another

175
00:14:30,050 --> 00:14:27,779
question for you Siobhan msh 24x on

176
00:14:32,030 --> 00:14:30,060
Instagram asks what did you guys learn

177
00:14:34,850 --> 00:14:32,040
from Curiosity and how did it affect

178
00:14:37,550 --> 00:14:34,860
perseverance's design

179
00:14:38,990 --> 00:14:37,560
we actually really appreciated the fact

180
00:14:42,410 --> 00:14:39,000
that we could

181
00:14:44,030 --> 00:14:42,420
analyze curiosity's designs both in All

182
00:14:46,250 --> 00:14:44,040
Phases of mission the crews the entry

183
00:14:48,710 --> 00:14:46,260
descent and landing and the surface and

184
00:14:51,050 --> 00:14:48,720
to make the changes to improve on it for

185
00:14:53,389 --> 00:14:51,060
the parts that we could now we had to be

186
00:14:56,329 --> 00:14:53,399
very targeted about what those changes

187
00:14:58,310 --> 00:14:56,339
were so we sought to improve in key

188
00:15:01,189 --> 00:14:58,320

targeted areas and then we added to

189
00:15:04,970 --> 00:15:01,199
curiosity design to allow perseverance

190
00:15:08,750 --> 00:15:04,980
to enable its Mission by adding the new

191
00:15:11,889 --> 00:15:08,760
sample capture system adding better

192
00:15:15,050 --> 00:15:11,899
Wheels in order to allow perseverance to

193
00:15:16,610 --> 00:15:15,060
drive farther and faster adding the

194
00:15:19,009 --> 00:15:16,620
whole terrain narrative navigation

195
00:15:21,170 --> 00:15:19,019
system to allow perseverance to land

196
00:15:23,210 --> 00:15:21,180
more accurately than curiosity could if

197
00:15:25,009 --> 00:15:23,220
you kind of see some of that in this

198
00:15:26,870 --> 00:15:25,019
optimism Rover behind you because it's a

199
00:15:29,650 --> 00:15:26,880
twin correct this is the twin of

200
00:15:32,810 --> 00:15:29,660
perseverance correct great now Rachel

201
00:15:34,790 --> 00:15:32,820
Astro John Jocelyn on Instagram asks

202
00:15:36,889 --> 00:15:34,800
what is the most interesting Discovery

203
00:15:38,569 --> 00:15:36,899
the Rover has made so far yeah that's a

204
00:15:40,370 --> 00:15:38,579
great question and so like I said we

205
00:15:42,530 --> 00:15:40,380
came to our Landing site Jezreel crater

206
00:15:44,569 --> 00:15:42,540
to look at the ancient Delta system that

207
00:15:46,310 --> 00:15:44,579
we have preserved there now we've spent

208
00:15:48,470 --> 00:15:46,320
most of our time so far exploring the

209
00:15:49,850 --> 00:15:48,480
crater floor and leading up to Landing

210
00:15:51,769 --> 00:15:49,860
we weren't really sure what we were

211
00:15:54,230 --> 00:15:51,779
going to see once we landed on the in

212
00:15:55,550 --> 00:15:54,240
the crater and explore the geology and

213
00:15:57,230 --> 00:15:55,560

the rocks that make up the crater floor

214
00:15:58,850 --> 00:15:57,240
it was actually kind of interesting

215
00:16:01,490 --> 00:15:58,860
because our science team was sort of

216
00:16:03,290 --> 00:16:01,500
split 50 50 in groups that thought we

217
00:16:05,449 --> 00:16:03,300
would see sedimentary rocks on the

218
00:16:07,430 --> 00:16:05,459
crater floor so things like Lake

219
00:16:09,170 --> 00:16:07,440
deposits similar to what Curiosity has

220
00:16:10,430 --> 00:16:09,180
been seeing in Gale crater whereas the

221
00:16:12,889 --> 00:16:10,440
other half of the team kind of thought

222
00:16:14,329 --> 00:16:12,899
we might be seeing igneous rocks in the

223
00:16:16,490 --> 00:16:14,339
surface exposures on the crater floor

224
00:16:17,689 --> 00:16:16,500
after a couple of months of exploration

225
00:16:19,670 --> 00:16:17,699
and a couple of samples that we've

226
00:16:20,930 --> 00:16:19,680
collected we've actually confirmed that

227
00:16:22,610 --> 00:16:20,940
that almost all of the rocks that we've

228
00:16:24,230 --> 00:16:22,620
been seeing in the crater floor are

229
00:16:26,449 --> 00:16:24,240
indeed igneous in origin so that's been

230
00:16:28,610 --> 00:16:26,459
a surprise to us thanks Rachel now

231
00:16:30,829 --> 00:16:28,620
taking it back to entry descent and

232
00:16:34,069 --> 00:16:30,839
Landing swathi free advice on Twitter

233
00:16:36,650 --> 00:16:34,079
asks did you have any backup plans in

234
00:16:38,689 --> 00:16:36,660
case any failures happened including the

235
00:16:40,910 --> 00:16:38,699
landing

236
00:16:43,910 --> 00:16:40,920
so when we designed entry descent and

237
00:16:45,650 --> 00:16:43,920
Landing it's really hard to test that in

238
00:16:48,470 --> 00:16:45,660

Earth because you can't put it together

239
00:16:50,449 --> 00:16:48,480
all the way so to make sure we have all

240
00:16:53,210 --> 00:16:50,459
our bases covered we do try to build in

241
00:16:55,670 --> 00:16:53,220
as much protections as we can because

242
00:16:58,249 --> 00:16:55,680
the Rover has to do it all on its own

243
00:17:00,230 --> 00:16:58,259
there's no opportunity for us in Mission

244
00:17:02,329 --> 00:17:00,240
Control to be able to to give the Rover

245
00:17:04,850 --> 00:17:02,339
any instruction to change so for example

246
00:17:07,069 --> 00:17:04,860
one of the nice backup features that we

247
00:17:09,650 --> 00:17:07,079
had was that if we had any hiccups with

248
00:17:11,270 --> 00:17:09,660
the main computer that was controlling

249
00:17:14,329 --> 00:17:11,280
during entry descent Landing we did

250
00:17:16,730 --> 00:17:14,339
actually have a mechanism that we had

251
00:17:18,409 --> 00:17:16,740
the backup computer on standby that if

252
00:17:20,510 --> 00:17:18,419
something happened we could swap to the

253
00:17:22,850 --> 00:17:20,520
backup computer and continue entry

254
00:17:25,309 --> 00:17:22,860
descent and Landing successfully

255
00:17:27,770 --> 00:17:25,319
yeah and speaking of all the cool Parts

256
00:17:29,630 --> 00:17:27,780
Rachel Nick on Instagram asks what is

257
00:17:31,850 --> 00:17:29,640
the coolest piece of technology on the

258
00:17:33,289 --> 00:17:31,860
Rover that helps scientists gather info

259
00:17:35,450 --> 00:17:33,299
oh gosh that's another tough one it's

260
00:17:36,650 --> 00:17:35,460
hard to choose just one I think you know

261
00:17:38,210 --> 00:17:36,660
with all of the missions that we've been

262
00:17:39,890 --> 00:17:38,220
sending to Mars it's really important to

263
00:17:41,930 --> 00:17:39,900

be able to interpret the geology of our

264
00:17:43,610 --> 00:17:41,940
Landing site and we do that mostly by

265
00:17:45,350 --> 00:17:43,620
taking pictures of our surroundings so I

266
00:17:46,730 --> 00:17:45,360
would have to say if I had to pick a

267
00:17:48,669 --> 00:17:46,740
piece of technology it would probably be

268
00:17:52,010 --> 00:17:48,679
the cameras that we have on perseverance

269
00:17:53,930 --> 00:17:52,020
perseverance has 23 cameras many of them

270
00:17:56,630 --> 00:17:53,940
are color cameras some of them can even

271
00:17:58,190 --> 00:17:56,640
zoom and so we we can really image all

272
00:17:59,990 --> 00:17:58,200
of our surroundings in really incredible

273
00:18:01,850 --> 00:18:00,000
detail with perseverance

274
00:18:05,510 --> 00:18:01,860
thanks Rachel lots of questions coming

275
00:18:08,090 --> 00:18:05,520
in swathi Juan Camillo on Instagram asks

276
00:18:10,430 --> 00:18:08,100
what programming languages are involved

277
00:18:12,289 --> 00:18:10,440
in the Rover's daily functions

278
00:18:14,450 --> 00:18:12,299
that's a good question actually so the

279
00:18:16,370 --> 00:18:14,460
software on board the Rover is primarily

280
00:18:18,110 --> 00:18:16,380
in C but we use many different languages

281
00:18:20,510 --> 00:18:18,120
here on the ground to do different

282
00:18:22,430 --> 00:18:20,520
functions like analyzing data or running

283
00:18:25,370 --> 00:18:22,440
test scripts so we've used things like

284
00:18:26,390 --> 00:18:25,380
Python and Matlab and see here on the

285
00:18:28,010 --> 00:18:26,400
ground in a variety of different

286
00:18:29,150 --> 00:18:28,020
functions to help the Rover do its

287
00:18:32,750 --> 00:18:29,160
operations

288
00:18:35,090 --> 00:18:32,760

and 24 7 canes on YouTube asks what have

289
00:18:37,010 --> 00:18:35,100
we learned about the weather on Mars and

290
00:18:38,029 --> 00:18:37,020
how would it affect future missions I

291
00:18:40,190 --> 00:18:38,039
don't know which one of you would like

292
00:18:42,350 --> 00:18:40,200
to take that I can take that so we have

293
00:18:43,789 --> 00:18:42,360
a couple of instruments on Mars that are

294
00:18:45,830 --> 00:18:43,799
on perseverance that are helping us

295
00:18:47,750 --> 00:18:45,840
characterize the daily environment we

296
00:18:49,130 --> 00:18:47,760
have an instrument called meta which is

297
00:18:50,990 --> 00:18:49,140
sort of our like our weather station on

298
00:18:52,970 --> 00:18:51,000
Mars and so we're looking at things like

299
00:18:54,590 --> 00:18:52,980
the weather the radiation the dynamic

300
00:18:56,930 --> 00:18:54,600
environment that's changing every day on

301
00:18:58,970 --> 00:18:56,940
Mars and we found that there's quite an

302
00:19:00,730 --> 00:18:58,980
active atmospheric cycle on Mars with

303
00:19:04,070 --> 00:19:00,740
perseverance so far

304
00:19:05,570 --> 00:19:04,080
and Scout on YouTube first off gives you

305
00:19:08,510 --> 00:19:05,580
a shout out thank you for all the

306
00:19:11,210 --> 00:19:08,520
amazing work on the mission now what is

307
00:19:13,370 --> 00:19:11,220
on the horizon for two years in terms of

308
00:19:16,130 --> 00:19:13,380
scientific goals experiments with the

309
00:19:17,630 --> 00:19:16,140
Rover and possibly helicopter yeah so we

310
00:19:18,950 --> 00:19:17,640
have a couple of main mission objectives

311
00:19:20,450 --> 00:19:18,960
that we hope to accomplish with

312
00:19:22,130 --> 00:19:20,460
perseverance the first is to

313
00:19:23,690 --> 00:19:22,140

characterize the geology of our Landing

314
00:19:25,549 --> 00:19:23,700
site which we've been hard at work doing

315
00:19:27,590 --> 00:19:25,559
in the last year looking at the crater

316
00:19:29,510 --> 00:19:27,600
floor looking forward we're going to be

317
00:19:31,669 --> 00:19:29,520
exploring the delta in the next year of

318
00:19:33,409 --> 00:19:31,679
our mission and then beyond

319
00:19:34,610 --> 00:19:33,419
beyond the Delta looking at sort of the

320
00:19:36,830 --> 00:19:34,620
margin of the crater and hopefully

321
00:19:39,169 --> 00:19:36,840
beyond the crater itself in future years

322
00:19:41,330 --> 00:19:39,179
with the mission we also plan to look

323
00:19:42,710 --> 00:19:41,340
for signs of ancient life in the rocks

324
00:19:44,090 --> 00:19:42,720
that we're exploring in Jezreel crater

325
00:19:46,430 --> 00:19:44,100
and so we have a really sophisticated

326
00:19:48,830 --> 00:19:46,440
set of scientific instruments to tell us

327
00:19:50,390 --> 00:19:48,840
about the mineral mineralogy and texture

328
00:19:51,350 --> 00:19:50,400
of the rocks in a really fine scale

329
00:19:53,270 --> 00:19:51,360
detail

330
00:19:54,950 --> 00:19:53,280
and so we're constantly learning more

331
00:19:56,029 --> 00:19:54,960
about the geology around us and we're

332
00:19:57,350 --> 00:19:56,039
going to be exploring a whole bunch of

333
00:19:58,549 --> 00:19:57,360
really exciting places over the next

334
00:20:00,409 --> 00:19:58,559
couple of years

335
00:20:02,390 --> 00:20:00,419
and we have a question from Richard on

336
00:20:03,830 --> 00:20:02,400
YouTube who wants to know does Ingenuity

337
00:20:06,110 --> 00:20:03,840
need to be in the line of sight to

338
00:20:09,409 --> 00:20:06,120

communicate with the Rover like how far

339
00:20:11,810 --> 00:20:09,419
away could it be to stay in contact

340
00:20:13,850 --> 00:20:11,820
I can take a stab at that one yeah so we

341
00:20:15,649 --> 00:20:13,860
can also do also get back to them too I

342
00:20:18,710 --> 00:20:15,659
can well I can speak a little bit to the

343
00:20:21,289 --> 00:20:18,720
to the the helicopter so uh our sidekick

344
00:20:23,750 --> 00:20:21,299
helicopter Ingenuity was meant mostly to

345
00:20:25,310 --> 00:20:23,760
be a technology demonstration for uh to

346
00:20:26,930 --> 00:20:25,320
be able to demonstrate that we can

347
00:20:30,350 --> 00:20:26,940
achieve powered flight on another planet

348
00:20:32,390 --> 00:20:30,360
and in uh sort of standard NASA fashion

349
00:20:35,090 --> 00:20:32,400
we really exceeded our expectations with

350
00:20:37,130 --> 00:20:35,100
Ingenuity and transitioned more into an

351
00:20:39,230 --> 00:20:37,140
operations demonstration with the

352
00:20:41,149 --> 00:20:39,240
helicopter and so Ingenuity has been

353
00:20:42,529 --> 00:20:41,159
really helpful in sort of scouting the

354
00:20:44,090 --> 00:20:42,539
places that we want to visit and places

355
00:20:46,010 --> 00:20:44,100
that we actually can't visit because of

356
00:20:48,289 --> 00:20:46,020
the terrain with perseverance and so

357
00:20:50,149 --> 00:20:48,299
we've been using we've been using

358
00:20:51,649 --> 00:20:50,159
Ingenuity so far in the last year beyond

359
00:20:53,330 --> 00:20:51,659
our technology demonstration to help us

360
00:20:56,450 --> 00:20:53,340
plan in operations

361
00:20:58,669 --> 00:20:56,460
and then said 91 EK on Instagram asks

362
00:21:01,190 --> 00:20:58,679
why doesn't the Rover examine the

363
00:21:02,630 --> 00:21:01,200

samples that it collects yeah that's a

364
00:21:05,029 --> 00:21:02,640
good question and it turns out that we

365
00:21:06,590 --> 00:21:05,039
actually do in a way and so when we find

366
00:21:08,690 --> 00:21:06,600
a rock that we're interested in sampling

367
00:21:11,510 --> 00:21:08,700
we drive up to it but before we collect

368
00:21:13,130 --> 00:21:11,520
a rock core sample we actually use one

369
00:21:15,289 --> 00:21:13,140
of our different coring bits called an

370
00:21:17,630 --> 00:21:15,299
abrasion bit and what our abrasion bit

371
00:21:19,730 --> 00:21:17,640
allows us to do is drill the upper

372
00:21:21,289 --> 00:21:19,740
couple millimeters of the surface and

373
00:21:23,810 --> 00:21:21,299
reveal sort of a five centimeter

374
00:21:25,250 --> 00:21:23,820
abrasion patch that lets us use our

375
00:21:26,990 --> 00:21:25,260
scientific instruments that we can put

376
00:21:29,690 --> 00:21:27,000
in very close proximity to that fresh

377
00:21:31,190 --> 00:21:29,700
surface to tell us in really fine detail

378
00:21:32,870 --> 00:21:31,200
what the minerals what minerals are

379
00:21:34,190 --> 00:21:32,880
there elements are there and what the

380
00:21:36,470 --> 00:21:34,200
texture looks like at a really fine

381
00:21:37,970 --> 00:21:36,480
scale and so once we're done with the

382
00:21:39,950 --> 00:21:37,980
abrasion and the analysis of the

383
00:21:41,330 --> 00:21:39,960
abrasion patch we can then choose our

384
00:21:42,950 --> 00:21:41,340
coring Target and we normally pick a

385
00:21:45,289 --> 00:21:42,960
coring Target that's pretty close to the

386
00:21:48,350 --> 00:21:45,299
abrasion patch and of course once we

387
00:21:50,270 --> 00:21:48,360
collect our core sample it gets um

388
00:21:52,789 --> 00:21:50,280

sealed into one of these Ultra Clean

389
00:21:55,010 --> 00:21:52,799
sample tubes this is a full scale model

390
00:21:56,990 --> 00:21:55,020
of what the sample tubes look like and

391
00:21:59,270 --> 00:21:57,000
once we collect the sample into the tube

392
00:22:00,710 --> 00:21:59,280
of course it gets sealed and stored for

393
00:22:02,990 --> 00:22:00,720
later retrieval to Earth hopefully in

394
00:22:04,430 --> 00:22:03,000
the future but once it's in the tube we

395
00:22:06,770 --> 00:22:04,440
can't analyze it like you mentioned in

396
00:22:07,970 --> 00:22:06,780
your question and so by studying our

397
00:22:10,190 --> 00:22:07,980
abrasion patch with our science

398
00:22:12,230 --> 00:22:10,200
instruments we use that data sort of as

399
00:22:13,909 --> 00:22:12,240
a proxy to help us understand what we

400
00:22:15,890 --> 00:22:13,919
could be expecting to find in our core

401
00:22:17,990 --> 00:22:15,900
samples and how many samples have you

402
00:22:20,390 --> 00:22:18,000
collected So Far So Far We've collected

403
00:22:22,370 --> 00:22:20,400
six Rock cores of the CR of the crater

404
00:22:24,470 --> 00:22:22,380
floor in our past year we're hoping to

405
00:22:26,330 --> 00:22:24,480
collect about two more before we wrap up

406
00:22:29,210 --> 00:22:26,340
our activities on the crater floor

407
00:22:32,390 --> 00:22:29,220
now twalo and YouTube ask is the Mars

408
00:22:35,029 --> 00:22:32,400
rover behind us real or is it a copy of

409
00:22:37,730 --> 00:22:35,039
it uh it'll be nice to speak more of a

410
00:22:40,130 --> 00:22:37,740
swathi if you want to kind of touch on

411
00:22:42,049 --> 00:22:40,140
what parts were part of edl and then

412
00:22:44,510 --> 00:22:42,059
maybe entry descendant Landing I should

413
00:22:47,210 --> 00:22:44,520

say and Rachel talk more about the

414
00:22:49,669 --> 00:22:47,220
science uh go ahead sure so optimism is

415
00:22:51,890 --> 00:22:49,679
real it's a fully functioning Rover that

416
00:22:54,470 --> 00:22:51,900
we use here on Earth so it does have a

417
00:22:57,649 --> 00:22:54,480
few modifications from the Rover that is

418
00:22:59,390 --> 00:22:57,659
on Mars primarily to allow it to work

419
00:23:01,010 --> 00:22:59,400
here on the earth so the wheels are a

420
00:23:03,649 --> 00:23:01,020
little bit different in terms of

421
00:23:07,310 --> 00:23:03,659
suspension to handle the Earth gravity

422
00:23:09,289 --> 00:23:07,320
but in terms of the electronics on board

423
00:23:11,870 --> 00:23:09,299
in terms of the cameras and the

424
00:23:14,390 --> 00:23:11,880
processing we try to make it as similar

425
00:23:17,270 --> 00:23:14,400
to perseverance as we can so that when

426
00:23:19,490 --> 00:23:17,280
we are testing our sequences our

427
00:23:21,590 --> 00:23:19,500
planning here on the ground we can have

428
00:23:23,930 --> 00:23:21,600
a really good expectation of how it'll

429
00:23:25,549 --> 00:23:23,940
work once it's on Mars

430
00:23:27,289 --> 00:23:25,559
yeah and then from a science perspective

431
00:23:28,970 --> 00:23:27,299
you can see mock-ups of all the

432
00:23:30,590 --> 00:23:28,980
different instruments that we have on

433
00:23:32,090 --> 00:23:30,600
the Rover on Mars for real so we can see

434
00:23:34,010 --> 00:23:32,100
looking at us here as one of our cameras

435
00:23:36,049 --> 00:23:34,020
on the end of the robotic arm we also

436
00:23:37,370 --> 00:23:36,059
have the remote sensing Mast which at

437
00:23:39,289 --> 00:23:37,380
the moment is pointed away from us but

438
00:23:41,390 --> 00:23:39,299

has a couple of additional cameras on

439
00:23:45,529 --> 00:23:41,400
top of it that serve as sort of our eyes

440
00:23:47,710 --> 00:23:45,539
as we're exploring the terrain around us

441
00:23:50,570 --> 00:23:47,720
great and then

442
00:23:52,310 --> 00:23:50,580
olesky on YouTube asks what was the

443
00:23:55,490 --> 00:23:52,320
biggest challenge during the mission

444
00:23:59,029 --> 00:23:57,409
oh that's a that's an interesting

445
00:24:02,029 --> 00:23:59,039
question there was a lot of challenges

446
00:24:04,370 --> 00:24:02,039
during development but from my

447
00:24:07,029 --> 00:24:04,380
perspective as the guidance navigation

448
00:24:09,649 --> 00:24:07,039
operations lead I would have to say

449
00:24:11,990 --> 00:24:09,659
rethinking how we had to do operations

450
00:24:14,090 --> 00:24:12,000
and our final assembly in the light of

451
00:24:16,549 --> 00:24:14,100
the pandemic was one of the big

452
00:24:18,950 --> 00:24:16,559
challenges you know we've never had to

453
00:24:21,289 --> 00:24:18,960
fly a mission like that and it was

454
00:24:23,570 --> 00:24:21,299
constantly a tug of war between the

455
00:24:25,970 --> 00:24:23,580
Personnel safety here on Earth and the

456
00:24:28,370 --> 00:24:25,980
safety of our Hardware either in space

457
00:24:30,590 --> 00:24:28,380
or in the final assembly so constantly

458
00:24:32,690 --> 00:24:30,600
having to make those trades as to how we

459
00:24:34,970 --> 00:24:32,700
were going to balance and how we would

460
00:24:37,970 --> 00:24:34,980
rethink what it meant to be working

461
00:24:39,649 --> 00:24:37,980
remotely with our spacecraft was a big

462
00:24:40,909 --> 00:24:39,659
Challenge and I'm really impressed at

463
00:24:43,669 --> 00:24:40,919

the team for pulling together and

464
00:24:45,289 --> 00:24:43,679
pulling through for an on-time launch in

465
00:24:47,029 --> 00:24:45,299
spite of the pandemic hitting just a few

466
00:24:48,590 --> 00:24:47,039
months before launch and making it all

467
00:24:50,630 --> 00:24:48,600
the way to Mars for a very successful

468
00:24:53,630 --> 00:24:50,640
landing and the entire time we've spent

469
00:24:56,390 --> 00:24:53,640
since then working as a pandemic's been

470
00:24:58,370 --> 00:24:56,400
ongoing we made the whole thing look

471
00:25:00,649 --> 00:24:58,380
easy congratulations to the team on that

472
00:25:01,789 --> 00:25:00,659
Rachel what about for you yeah since

473
00:25:03,529 --> 00:25:01,799
we've been on the surface we've

474
00:25:05,630 --> 00:25:03,539
encountered our fair share of curveballs

475
00:25:07,549 --> 00:25:05,640
from Mars too I mentioned the first time

476
00:25:09,890 --> 00:25:07,559
that we sent our sampling plan up to the

477
00:25:12,529 --> 00:25:09,900
Rover to collect a sample in one of our

478
00:25:14,450 --> 00:25:12,539
sample tubes uh once that plan executed

479
00:25:16,250 --> 00:25:14,460
on Mars everything worked perfectly from

480
00:25:17,810 --> 00:25:16,260
our Hardware perspective but then when

481
00:25:19,370 --> 00:25:17,820
we started to analyze the data that came

482
00:25:21,289 --> 00:25:19,380
down we actually saw that the tube was

483
00:25:23,510 --> 00:25:21,299
empty and didn't contain a rock sample

484
00:25:25,850 --> 00:25:23,520
as we were anticipating it would and so

485
00:25:27,769 --> 00:25:25,860
we constantly have to adapt as Mars

486
00:25:29,930 --> 00:25:27,779
throws us curveballs and challenges but

487
00:25:31,909 --> 00:25:29,940
everything from the Rover perspective

488
00:25:34,430 --> 00:25:31,919

has been working flawlessly

489
00:25:36,710 --> 00:25:34,440
great and first of all the Tyler

490
00:25:39,169 --> 00:25:36,720
Williamson on YouTube asks actually for

491
00:25:41,690 --> 00:25:39,179
both of you what type of degree do you

492
00:25:44,090 --> 00:25:41,700
need to become a NASA engineer

493
00:25:46,070 --> 00:25:44,100
that's a great question there are so

494
00:25:48,890 --> 00:25:46,080
many different ways to contribute to

495
00:25:51,710 --> 00:25:48,900
NASA you know we generally like to look

496
00:25:52,970 --> 00:25:51,720
for some degrees in science and

497
00:25:55,430 --> 00:25:52,980
technology and it doesn't have to be

498
00:25:56,990 --> 00:25:55,440
just one particular area of of science

499
00:25:59,750 --> 00:25:57,000
or one particular area of engineering

500
00:26:01,430 --> 00:25:59,760
you know find what makes you the most

501
00:26:03,529 --> 00:26:01,440
interested where your passion is and

502
00:26:06,409 --> 00:26:03,539
there's so many different ways to apply

503
00:26:09,590 --> 00:26:06,419
that to NASA programs whether it's you

504
00:26:12,169 --> 00:26:09,600
know geology of mars or chemistry as we

505
00:26:13,850 --> 00:26:12,179
think of planetary protection or you

506
00:26:15,409 --> 00:26:13,860
know even biology as humans go into

507
00:26:17,149 --> 00:26:15,419
space flight or in the traditional like

508
00:26:19,310 --> 00:26:17,159
structures and controls and mechanisms

509
00:26:22,250 --> 00:26:19,320
you know we need all of those different

510
00:26:24,049 --> 00:26:22,260
fields in order to support NASA missions

511
00:26:25,669 --> 00:26:24,059
in addition to all the non-technical

512
00:26:27,950 --> 00:26:25,679
fields like the the writing and the

513
00:26:29,750 --> 00:26:27,960

publicity and things like that it's a

514
00:26:31,310 --> 00:26:29,760
wide range of jobs what about for you

515
00:26:32,630 --> 00:26:31,320
Rachel yeah I couldn't agree more I

516
00:26:34,370 --> 00:26:32,640
think one of my favorite things about

517
00:26:36,409 --> 00:26:34,380
being a part of the perseverance team is

518
00:26:38,510 --> 00:26:36,419
that no two team members have the same

519
00:26:40,130 --> 00:26:38,520
path or the same level of experience or

520
00:26:42,169 --> 00:26:40,140
background and so you really have to

521
00:26:43,909 --> 00:26:42,179
find what interests you and pursue that

522
00:26:46,909 --> 00:26:43,919
and work really hard

523
00:26:48,769 --> 00:26:46,919
and Erica on Twitter asks what do you

524
00:26:51,529 --> 00:26:48,779
hope to accomplish with this Mission

525
00:26:55,549 --> 00:26:53,750
oh yeah so I can I can touch on that

526
00:26:57,350 --> 00:26:55,559
first so we talked a little bit about

527
00:26:58,789 --> 00:26:57,360
sort of the the mission objectives that

528
00:27:01,070 --> 00:26:58,799
we hope to accomplish with perseverance

529
00:27:02,870 --> 00:27:01,080
at the top of the list for for many

530
00:27:04,970 --> 00:27:02,880
reasons and for the the future missions

531
00:27:07,130 --> 00:27:04,980
that swathi talked about is to collect

532
00:27:09,049 --> 00:27:07,140
samples and so we brought over 40 sample

533
00:27:11,269 --> 00:27:09,059
tubes with us to Mars and we hope to

534
00:27:13,010 --> 00:27:11,279
fill most of those with samples of

535
00:27:14,990 --> 00:27:13,020
Martian Rock and soil to eventually

536
00:27:17,330 --> 00:27:15,000
bring back to analyze here on Earth

537
00:27:19,010 --> 00:27:17,340
and so when we when we had the chance to

538
00:27:20,750 --> 00:27:19,020

bring those samples back to Earth we can

539
00:27:22,789 --> 00:27:20,760
actually unleash the whole arsenal of

540
00:27:25,250 --> 00:27:22,799
the scientific Community here on Earth

541
00:27:28,310 --> 00:27:25,260
to look at those samples and to look at

542
00:27:30,710 --> 00:27:28,320
them in the hopes of finding signs of

543
00:27:33,590 --> 00:27:30,720
ancient Life on Mars and if we can

544
00:27:35,570 --> 00:27:33,600
find those signs of Life on Mars even

545
00:27:38,450 --> 00:27:35,580
ancient life that would fundamentally

546
00:27:40,070 --> 00:27:38,460
change how we look at how life evolved

547
00:27:42,529 --> 00:27:40,080
here on Earth and whether there's life

548
00:27:45,649 --> 00:27:42,539
elsewhere in the galaxy

549
00:27:47,570 --> 00:27:45,659
and a letter on YouTube asks I feel like

550
00:27:49,730 --> 00:27:47,580
this is rhetorical how does it feel to

551
00:27:51,590 --> 00:27:49,740
be an awesome lady scientist and

552
00:27:53,690 --> 00:27:51,600
engineer

553
00:27:55,610 --> 00:27:53,700
oh it's fantastic and and just

554
00:27:57,289 --> 00:27:55,620
revisiting what I said earlier it's just

555
00:27:59,450 --> 00:27:57,299
so humbling to be part of such an

556
00:28:01,190 --> 00:27:59,460
amazing team everybody is extremely

557
00:28:03,470 --> 00:28:01,200
supportive we have a very diverse team

558
00:28:05,570 --> 00:28:03,480
and it makes everything that we do even

559
00:28:07,990 --> 00:28:05,580
that more satisfying

560
00:28:11,149 --> 00:28:08,000
I totally second Rachel yes

561
00:28:13,130 --> 00:28:11,159
perfectly said mg Steve on YouTube asks

562
00:28:15,049 --> 00:28:13,140
are you concerned about the samples

563
00:28:16,909 --> 00:28:15,059

being covered by dust on the surface

564
00:28:19,610 --> 00:28:16,919
before a mission recovery can pick them

565
00:28:21,710 --> 00:28:19,620
up that's a really good question and so

566
00:28:23,029 --> 00:28:21,720
the samples will be securely stored in

567
00:28:24,950 --> 00:28:23,039
these sample tubes like we mentioned

568
00:28:26,450 --> 00:28:24,960
earlier and we're still working out the

569
00:28:28,010 --> 00:28:26,460
details of exactly how we're going to be

570
00:28:30,169 --> 00:28:28,020
depositing these samples on the surface

571
00:28:32,690 --> 00:28:30,179
for eventual pickup and return to Earth

572
00:28:34,909 --> 00:28:32,700
we know that Mars has a very active

573
00:28:36,230 --> 00:28:34,919
Dynamic atmosphere and so we see you

574
00:28:37,909 --> 00:28:36,240
know dust storms and things like that

575
00:28:39,950 --> 00:28:37,919
that affect the Rover and other missions

576
00:28:41,750 --> 00:28:39,960
across the planet but we're not really

577
00:28:43,190 --> 00:28:41,760
too concerned about our ability to to

578
00:28:45,409 --> 00:28:43,200
see the samples when we're ready to pick

579
00:28:47,690 --> 00:28:45,419
them up lots of questions of the Rover

580
00:28:50,389 --> 00:28:47,700
coming in Jake Kendall on Instagram asks

581
00:28:52,070 --> 00:28:50,399
how is maintenance conducted

582
00:28:53,930 --> 00:28:52,080
well that's a good one from at least a

583
00:28:55,549 --> 00:28:53,940
science perspective uh you know we have

584
00:28:57,230 --> 00:28:55,559
a whole bunch of science instruments on

585
00:28:58,909 --> 00:28:57,240
the Rover and we're constantly making

586
00:29:00,950 --> 00:28:58,919
sure that our instruments are working

587
00:29:02,750 --> 00:29:00,960
properly we have calibration Targets on

588
00:29:04,130 --> 00:29:02,760

the Rover that we periodically check to

589
00:29:06,110 --> 00:29:04,140
make sure that the data that we're

590
00:29:07,490 --> 00:29:06,120
acquiring is very high quality so we're

591
00:29:09,409 --> 00:29:07,500
kind of periodically as we're going

592
00:29:10,669 --> 00:29:09,419
checking in on our on our instruments

593
00:29:13,010 --> 00:29:10,679
and I'm over to make sure everything is

594
00:29:15,769 --> 00:29:13,020
healthy from the from the engineering

595
00:29:17,750 --> 00:29:15,779
side we also do ongoing maintenance we

596
00:29:19,070 --> 00:29:17,760
make sure to Trend all of the data that

597
00:29:20,750 --> 00:29:19,080
we're getting back from the Rover to

598
00:29:22,930 --> 00:29:20,760
make sure it's performing as we expect

599
00:29:24,830 --> 00:29:22,940
if we have to do any

600
00:29:27,230 --> 00:29:24,840
tuning of the Rover to upgrade

601
00:29:28,669 --> 00:29:27,240
parameters to to properly capture what

602
00:29:30,470 --> 00:29:28,679
the state of the Rover is we have those

603
00:29:33,049 --> 00:29:30,480
built into the plan to do periodic

604
00:29:36,350 --> 00:29:33,059
maintenance of The Rovers as it evolves

605
00:29:38,330 --> 00:29:36,360
on Mars and swara on YouTube wants to

606
00:29:40,970 --> 00:29:38,340
know how was Landing different from

607
00:29:42,950 --> 00:29:40,980
perseverance compared to curiosity or

608
00:29:46,190 --> 00:29:42,960
even the other Rovers

609
00:29:49,250 --> 00:29:46,200
oh can we can hear you're moving up

610
00:29:51,830 --> 00:29:49,260
there so curiosity

611
00:29:53,750 --> 00:29:51,840
there we go yeah go ahead

612
00:29:56,269 --> 00:29:53,760
optimism wants to hear our answer too

613
00:29:59,049 --> 00:29:56,279

actually curiosity and perseverance

614
00:30:01,789 --> 00:29:59,059
Landings were actually very similar

615
00:30:04,210 --> 00:30:01,799
perseverance had a few upgrades compared

616
00:30:07,669 --> 00:30:04,220
to curiosity that allowed it to land

617
00:30:10,490 --> 00:30:07,679
much more accurately than curiosity did

618
00:30:12,049 --> 00:30:10,500
very targeted upgrades one in terms of

619
00:30:15,409 --> 00:30:12,059
how we deployed the parachute and

620
00:30:17,149 --> 00:30:15,419
another in terms of how we picked our

621
00:30:20,090 --> 00:30:17,159
Landing site to make sure we could find

622
00:30:23,750 --> 00:30:20,100
a safe spot in Jezreel crater curiosity

623
00:30:27,230 --> 00:30:23,760
and perseverance compared to Spirit and

624
00:30:29,810 --> 00:30:27,240
opportunity were a little bit different

625
00:30:32,750 --> 00:30:29,820
curiosity and perseverance actually had

626
00:30:35,149 --> 00:30:32,760
a guided entry system with the sky crane

627
00:30:37,610 --> 00:30:35,159
to actually lower the Rover onto the

628
00:30:39,529 --> 00:30:37,620
surface where I spare an opportunity had

629
00:30:42,049 --> 00:30:39,539
a parachute and then it would inflate

630
00:30:44,570 --> 00:30:42,059
these airbags around them uh deploy them

631
00:30:45,889 --> 00:30:44,580
they would kind of Bounce and then the

632
00:30:47,570 --> 00:30:45,899
airbags would deflate and then the

633
00:30:49,970 --> 00:30:47,580
Rovers would open up and it would drive

634
00:30:51,590 --> 00:30:49,980
off from from those systems and this and

635
00:30:54,350 --> 00:30:51,600
this is the first time that we had this

636
00:30:55,970 --> 00:30:54,360
on video correct perseverance was the

637
00:30:58,970 --> 00:30:55,980
very first time that we could actually

638
00:31:00,529 --> 00:30:58,980

we had so many cameras recording during

639
00:31:01,909 --> 00:31:00,539
Landing that we could actually see

640
00:31:03,950 --> 00:31:01,919
things as it happened it was the first

641
00:31:06,169 --> 00:31:03,960
time that we saw the parachute open

642
00:31:08,269 --> 00:31:06,179
which was just an amazing feeling

643
00:31:09,590 --> 00:31:08,279
because that's one of our highest

644
00:31:11,630 --> 00:31:09,600
criticality things the parachute doesn't

645
00:31:15,289 --> 00:31:11,640
open you don't you don't get very far on

646
00:31:17,509 --> 00:31:15,299
Mars it could actually record the Rover

647
00:31:18,830 --> 00:31:17,519
being lowered from The Descent stage and

648
00:31:20,810 --> 00:31:18,840
it that was just incredible video it

649
00:31:23,450 --> 00:31:20,820
looked like uh an alien planet you know

650
00:31:25,190 --> 00:31:23,460
which maybe it sort of was but to be

651
00:31:26,509 --> 00:31:25,200
able to see that gave us so much more

652
00:31:28,370 --> 00:31:26,519
data than just the ones and zeros

653
00:31:30,049 --> 00:31:28,380
because now you can see everything was

654
00:31:31,430 --> 00:31:30,059
happening all the nuances associated

655
00:31:33,289 --> 00:31:31,440
with that associated with the parachute

656
00:31:36,110 --> 00:31:33,299
and the intricate Dynamics associated

657
00:31:37,909 --> 00:31:36,120
with how the bridles work to lower the

658
00:31:39,830 --> 00:31:37,919
Rover which is just immense amount of

659
00:31:41,149 --> 00:31:39,840
data that well I'm sure we'll spend so

660
00:31:44,509 --> 00:31:41,159
much time analyzing them for the future

661
00:31:46,549 --> 00:31:44,519
missions very Incredible video and how

662
00:31:48,590 --> 00:31:46,559
to Jonathan on YouTube wants to know to

663
00:31:51,950 --> 00:31:48,600

what extent is perseverance autonomous

664
00:31:52,789 --> 00:31:51,960
and how much does someone actually drive

665
00:31:54,710 --> 00:31:52,799
it

666
00:31:56,450 --> 00:31:54,720
yeah that's a great question and the way

667
00:31:59,330 --> 00:31:56,460
that we plan Mission operations with

668
00:32:01,009 --> 00:31:59,340
perseverance is that we send one to a

669
00:32:03,769 --> 00:32:01,019
multiple days worth of activities or

670
00:32:05,330 --> 00:32:03,779
solves up to the Rover at a time and so

671
00:32:07,130 --> 00:32:05,340
the Rover needs to have some level of

672
00:32:09,169 --> 00:32:07,140
autonomy to be able to perform those

673
00:32:10,850 --> 00:32:09,179
activities and at the end of the day we

674
00:32:13,190 --> 00:32:10,860
get those data down to plan the next

675
00:32:15,470 --> 00:32:13,200
day's activities we've we have a really

676
00:32:16,610 --> 00:32:15,480
incredible autonomous driving capability

677
00:32:18,590 --> 00:32:16,620
with perseverance that we're still

678
00:32:20,330 --> 00:32:18,600
evolving to this day that's allowing us

679
00:32:22,430 --> 00:32:20,340
to break all sorts of records for

680
00:32:24,769 --> 00:32:22,440
distances driven on Mars in a single

681
00:32:27,110 --> 00:32:24,779
cell so it's been really exciting do you

682
00:32:29,269 --> 00:32:27,120
by chance know like how far it's gone in

683
00:32:30,950 --> 00:32:29,279
a single day oh gosh I think we broke a

684
00:32:33,110 --> 00:32:30,960
record over Super Bowl weekend which was

685
00:32:34,970 --> 00:32:33,120
very appropriate I think we broke both

686
00:32:36,830 --> 00:32:34,980
the autonomous driving record and the

687
00:32:39,710 --> 00:32:36,840
actual wheels turning in a single saw

688
00:32:41,330 --> 00:32:39,720

record that's amazing Champ here now

689
00:32:42,950 --> 00:32:41,340
does Lou on Twitter wants to know does

690
00:32:45,049 --> 00:32:42,960
perseverance have a wake-up song like

691
00:32:46,669 --> 00:32:45,059
the other Rovers we do have a wake up

692
00:32:49,490 --> 00:32:46,679
song and we play that as we're sort of

693
00:32:51,110 --> 00:32:49,500
reviewing the data that come down uh to

694
00:32:52,490 --> 00:32:51,120
start our operations day and it's it's a

695
00:32:54,049 --> 00:32:52,500
different song every day and it kind of

696
00:32:56,090 --> 00:32:54,059
gets us in the mood to to plan our

697
00:32:58,490 --> 00:32:56,100
operations every day it's great and

698
00:33:00,470 --> 00:32:58,500
Tallow on YouTube wants to know will

699
00:33:01,970 --> 00:33:00,480
someone send another Rover to Mars to

700
00:33:03,830 --> 00:33:01,980
pick up the samples or will perseverance

701
00:33:06,289 --> 00:33:03,840
come back sometimes

702
00:33:07,789 --> 00:33:06,299
that's swathy you might know that one

703
00:33:09,649 --> 00:33:07,799
sure so

704
00:33:12,710 --> 00:33:09,659
I guess part of that question is whether

705
00:33:14,389 --> 00:33:12,720
perseverance will come back yeah

706
00:33:16,610 --> 00:33:14,399
yeah separation or if it's perseverance

707
00:33:18,230 --> 00:33:16,620
coming back you know there's still a lot

708
00:33:19,669 --> 00:33:18,240
of things that we need to work out with

709
00:33:21,830 --> 00:33:19,679
the whole campaign of how we're going to

710
00:33:23,570 --> 00:33:21,840
get these samples back there's uh

711
00:33:25,430 --> 00:33:23,580
multiple different pieces and how we

712
00:33:28,009 --> 00:33:25,440
work them together and so right now the

713
00:33:30,169 --> 00:33:28,019

option space is still open in terms of

714
00:33:32,210 --> 00:33:30,179
how we're going to get the samples back

715
00:33:33,649 --> 00:33:32,220
to the Lander with the rocket uh who's

716
00:33:35,750 --> 00:33:33,659
going to go get the samples whether it's

717
00:33:37,789 --> 00:33:35,760
perseverance or another Rover all those

718
00:33:39,049 --> 00:33:37,799
pieces are still being worked out we're

719
00:33:41,149 --> 00:33:39,059
still in the design phase of the

720
00:33:43,970 --> 00:33:41,159
campaign to start deciding this

721
00:33:45,710 --> 00:33:43,980
and then does perseverance communicate

722
00:33:47,389 --> 00:33:45,720
with other Rovers on Mars and how does

723
00:33:49,009 --> 00:33:47,399
it communicate with Earth this is Nikki

724
00:33:51,169 --> 00:33:49,019
on YouTube asking that's a great

725
00:33:52,549 --> 00:33:51,179
question as awesome as it would be to

726
00:33:54,169 --> 00:33:52,559
sort of chat with the other vehicles

727
00:33:56,450 --> 00:33:54,179
that we have on Mars they're all really

728
00:33:58,430 --> 00:33:56,460
far away from perseverance so we uh

729
00:34:35,869 --> 00:33:58,440
communicate with the Rover using our

730
00:34:39,649 --> 00:34:37,490
concerns to drive through so that's why

731
00:34:41,089 --> 00:34:39,659
we really like using Ingenuity to sort

732
00:34:43,909 --> 00:34:41,099
of get a feel for what these terrains

733
00:34:46,369 --> 00:34:43,919
look like from The helicopter's View

734
00:34:49,010 --> 00:34:46,379
and musical wolves on YouTube wants to

735
00:34:50,389 --> 00:34:49,020
ask how are the Rovers locations being

736
00:34:52,430 --> 00:34:50,399
tracked and we have time for two more

737
00:34:55,010 --> 00:34:52,440
questions after that how are they being

738
00:34:57,290 --> 00:34:55,020

tracked so so our our missions to Mars

739
00:34:59,450 --> 00:34:57,300
and our Rovers on Mars uh land in very

740
00:35:01,250 --> 00:34:59,460
specific Landing sites and so

741
00:35:02,690 --> 00:35:01,260
um as I mentioned we have satellites

742
00:35:04,310 --> 00:35:02,700
around Mars that sort of serve as our

743
00:35:06,530 --> 00:35:04,320
Communications relay we can also

744
00:35:08,150 --> 00:35:06,540
sometimes take images pointing down at

745
00:35:09,890 --> 00:35:08,160
our Landing sites to sort of check in on

746
00:35:11,150 --> 00:35:09,900
the Rovers to see what sort of progress

747
00:35:13,010 --> 00:35:11,160
we've been making so it's always really

748
00:35:15,829 --> 00:35:13,020
exciting to be able to see pictures of

749
00:35:20,150 --> 00:35:15,839
the Rover on Mars taken by a satellite

750
00:35:22,370 --> 00:35:20,160
and then to kick on YouTube asks how

751
00:35:25,010 --> 00:35:22,380
long my perseverance maintain enough

752
00:35:27,230 --> 00:35:25,020
power to conduct science

753
00:35:29,390 --> 00:35:27,240
so perseverance was actually designed

754
00:35:32,089 --> 00:35:29,400
for one and a half Mars years which is

755
00:35:34,849 --> 00:35:32,099
roughly about three Earth years that's

756
00:35:36,710 --> 00:35:34,859
how much it was designed for we've had

757
00:35:38,810 --> 00:35:36,720
Fairly good success rates for Rovers on

758
00:35:41,930 --> 00:35:38,820
Mars lasting you know eight to ten years

759
00:35:43,970 --> 00:35:41,940
past their initial design lives so

760
00:35:46,370 --> 00:35:43,980
fingers crossed that perseverance has a

761
00:35:48,290 --> 00:35:46,380
nice long feature ahead of her

762
00:35:50,329 --> 00:35:48,300
great and you know we always get

763
00:35:53,450 --> 00:35:50,339

questions like this uh how did you both

764
00:35:55,250 --> 00:35:53,460
get into your career fields

765
00:35:57,470 --> 00:35:55,260
I can start with that one so I actually

766
00:35:59,870 --> 00:35:57,480
grew up watching Star Trek so I loved

767
00:36:01,670 --> 00:35:59,880
the whole concept of space and exploring

768
00:36:03,050 --> 00:36:01,680
space but it wasn't until I was a junior

769
00:36:05,150 --> 00:36:03,060
in high school that I had a really great

770
00:36:07,010 --> 00:36:05,160
physics teacher and that opened me up to

771
00:36:09,109 --> 00:36:07,020
what engineering was and what it meant

772
00:36:10,849 --> 00:36:09,119
to build things that could actually go

773
00:36:12,710 --> 00:36:10,859
and do that exploration that's how I

774
00:36:16,010 --> 00:36:12,720
made my way to JPL

775
00:36:18,890 --> 00:36:16,020
so exciting yes my movie of inspiration

776
00:36:20,510 --> 00:36:18,900
uh was actually Apollo 13. so when I was

777
00:36:22,609 --> 00:36:20,520
young I was always really interested in

778
00:36:24,230 --> 00:36:22,619
NASA missions especially the Mercury

779
00:36:26,990 --> 00:36:24,240
Gemini and Apollo missions that brought

780
00:36:29,390 --> 00:36:27,000
astronauts to the moon in the 1960s so

781
00:36:31,550 --> 00:36:29,400
when I went to school I ended up finding

782
00:36:33,109 --> 00:36:31,560
a really strong interest in geology and

783
00:36:35,450 --> 00:36:33,119
so when I went to graduate school to get

784
00:36:38,270 --> 00:36:35,460
my PhD in geology I had the opportunity

785
00:36:40,130 --> 00:36:38,280
to join the Curiosity Rover team as a

786
00:36:41,510 --> 00:36:40,140
graduate student and once I got sort of

787
00:36:43,190 --> 00:36:41,520
my first taste of what it was like to

788
00:36:45,710 --> 00:36:43,200

work in science operations I was totally

789
00:36:48,410 --> 00:36:45,720
hooked and so afterward I came here to

790
00:36:50,210 --> 00:36:48,420
JPL and now I work for perseverance

791
00:36:53,390 --> 00:36:50,220
great to hear that you're both inspired

792
00:36:55,250 --> 00:36:53,400
by sci-fi programming that's great now

793
00:36:57,170 --> 00:36:55,260
that is all the time we have for

794
00:36:59,210 --> 00:36:57,180
questions today thank you so much for

795
00:37:00,950 --> 00:36:59,220
answering all of our questions and thank

796
00:37:03,349 --> 00:37:00,960
you everyone at home for your questions

797
00:37:06,170 --> 00:37:03,359
now to learn more about perseverance

798
00:37:09,310 --> 00:37:06,180
follow at Nasa persevere on our social