



1
00:00:08,089 --> 00:00:06,710
NASA's jet propulsion laboratory

2
00:00:11,089 --> 00:00:08,099
presents

3
00:00:13,129 --> 00:00:11,099
the Von Carmen lecture a series of Talks

4
00:00:15,890 --> 00:00:13,139
by scientists and Engineers who are

5
00:00:17,920 --> 00:00:15,900
exploring our planet our solar system

6
00:00:25,429 --> 00:00:17,930
and all that lies Beyond

7
00:00:27,890 --> 00:00:25,439
[Music]

8
00:00:30,050 --> 00:00:27,900
good evening folks wherever you may be I

9
00:00:32,150 --> 00:00:30,060
am Brian White from jpl's Office of

10
00:00:34,069 --> 00:00:32,160
communications and education and welcome

11
00:00:35,870 --> 00:00:34,079
to the Von Carmen series

12
00:00:37,910 --> 00:00:35,880
the Von Carmen talks are a monthly

13
00:00:40,610 --> 00:00:37,920

opportunity to engage with you the

14

00:00:41,990 --> 00:00:40,620

public this is your space program now as

15

00:00:43,549 --> 00:00:42,000

a reminder if we have any technical

16

00:00:45,350 --> 00:00:43,559

difficulties we ask that your patients

17

00:00:47,810 --> 00:00:45,360

as we get them sorted out because

18

00:00:50,209 --> 00:00:47,820

tonight we get to celebrate an

19

00:00:52,130 --> 00:00:50,219

anniversary the Mars 2020 Rover

20

00:00:54,830 --> 00:00:52,140

perseverance has been on Mars for the

21

00:00:56,930 --> 00:00:54,840

past year there's a lot to get to to

22

00:00:58,369 --> 00:00:56,940

talk about tonight so let's get started

23

00:01:01,250 --> 00:00:58,379

I'm going to first introduce our

24

00:01:04,250 --> 00:01:01,260

questions co-host Nikki Wyrick hi Nikki

25

00:01:05,270 --> 00:01:04,260

hi hi Brian it's good to see you for

26

00:01:07,370 --> 00:01:05,280

those of you joining us this evening

27

00:01:08,810 --> 00:01:07,380

please remember that we want you to get

28

00:01:10,850 --> 00:01:08,820

involved in the conversation as Brian

29

00:01:12,410 --> 00:01:10,860

said it is your space program so whether

30

00:01:15,469 --> 00:01:12,420

you're following Along on YouTube

31

00:01:17,630 --> 00:01:15,479

Facebook or LinkedIn put your questions

32

00:01:19,609 --> 00:01:17,640

in the chat to our diligent social media

33

00:01:21,770 --> 00:01:19,619

team and we will get to as many as we

34

00:01:23,690 --> 00:01:21,780

can if you don't see the chat make sure

35

00:01:25,130 --> 00:01:23,700

to refresh your page and you should see

36

00:01:27,109 --> 00:01:25,140

it then

37

00:01:29,090 --> 00:01:27,119

back over you Brian

38

00:01:30,649 --> 00:01:29,100

thank you very much Nikki now we have

39

00:01:32,870 --> 00:01:30,659

two incredible and accomplished speakers

40

00:01:34,249 --> 00:01:32,880

this evening and will be sprinkling in

41

00:01:36,289 --> 00:01:34,259

your audience questions throughout the

42

00:01:38,270 --> 00:01:36,299

talk our first Speaker holds a

43

00:01:39,590 --> 00:01:38,280

bachelor's in aerospace engineering from

44

00:01:41,090 --> 00:01:39,600

the Massachusetts Institute of

45

00:01:43,429 --> 00:01:41,100

Technology and a master of science

46

00:01:45,889 --> 00:01:43,439

degree and the same from the University

47

00:01:47,810 --> 00:01:45,899

of Southern California in the 30 years

48

00:01:49,550 --> 00:01:47,820

since her initial hiring here at the jet

49

00:01:53,330 --> 00:01:49,560

propulsion laboratory she has held

50

00:01:55,670 --> 00:01:53,340

critical engineering leadership roles on

51
00:01:57,469 --> 00:01:55,680
every spacecraft who have roved the

52
00:01:59,569 --> 00:01:57,479
surface of Mars she joined the

53
00:02:00,770 --> 00:01:59,579
perseverance team in 2015 and has held

54
00:02:02,090 --> 00:02:00,780
several leadership roles during the

55
00:02:04,609 --> 00:02:02,100
development and operations of the

56
00:02:07,670 --> 00:02:04,619
mission she is now the project manager

57
00:02:10,369 --> 00:02:07,680
of the Mars 2020 perseverance Rover

58
00:02:11,630 --> 00:02:10,379
please welcome Jennifer Trospen hi

59
00:02:14,809 --> 00:02:11,640
Jennifer

60
00:02:17,510 --> 00:02:14,819
hi Brian it's great to be here and it's

61
00:02:19,130 --> 00:02:17,520
a fun day to be here on our one year

62
00:02:20,990 --> 00:02:19,140
anniversary

63
00:02:22,550 --> 00:02:21,000

thank you for being here on this fun day

64

00:02:23,390 --> 00:02:22,560

thank you for taking the time

65

00:02:25,130 --> 00:02:23,400

um let's talk a little bit about

66

00:02:26,869 --> 00:02:25,140

engineering but let's talk about as you

67

00:02:28,190 --> 00:02:26,879

said a year into the mission

68

00:02:30,350 --> 00:02:28,200

it's I know it's going to be hard to

69

00:02:33,290 --> 00:02:30,360

narrow it down but what are one or two

70

00:02:35,630 --> 00:02:33,300

highlights of this past year

71

00:02:38,210 --> 00:02:35,640

well it is the what I call the land

72

00:02:40,910 --> 00:02:38,220

diversary so our one year anniversary of

73

00:02:45,170 --> 00:02:40,920

landing and certainly a huge highlight

74

00:02:47,390 --> 00:02:45,180

of the last year was February 18 2021 so

75

00:02:59,110 --> 00:02:47,400

let's go ahead and play the video to

76

00:03:05,630 --> 00:03:03,050

propulsion go CDL please

77

00:03:07,850 --> 00:03:05,640

we have Dean perseverance ready to

78

00:03:09,470 --> 00:03:07,860

execute entry descent and landing on her

79

00:03:11,509 --> 00:03:09,480

own

80

00:03:14,330 --> 00:03:11,519

confirmation of Entry interface

81

00:03:16,910 --> 00:03:14,340

presidents is currently going 5.3

82

00:03:21,110 --> 00:03:16,920

kilometers per second it's about 120

83

00:03:25,460 --> 00:03:23,930

it will start controlling its path to

84

00:03:27,890 --> 00:03:25,470

the landing Target

85

00:03:30,110 --> 00:03:27,900

[Music]

86

00:03:38,089 --> 00:03:30,120

parachute has deployed and we are seeing

87

00:03:44,570 --> 00:03:40,490

the heat shield has been separated first

88

00:03:44,580 --> 00:03:49,190

has separated

89

00:03:55,550 --> 00:03:52,190

maneuver has started about 20 meters off

90

00:04:01,610 --> 00:03:58,670

[Music]

91

00:04:06,960 --> 00:04:01,620

Tango Delta nominal touchdown confirmed

92

00:04:18,409 --> 00:04:11,510

[Applause]

93

00:04:23,410 --> 00:04:20,660

foreign

94

00:04:32,920 --> 00:04:23,420

[Applause]

95

00:04:45,740 --> 00:04:32,930

[Music]

96

00:04:51,510 --> 00:04:48,270

[Applause]

97

00:04:54,530 --> 00:04:51,520

[Music]

98

00:04:57,140 --> 00:04:54,540

[Applause]

99

00:04:59,710 --> 00:04:57,150

foreign

100

00:05:03,650 --> 00:04:59,720

[Music]

101
00:05:05,749 --> 00:05:03,660
well even now my heart is racing and the

102
00:05:07,430 --> 00:05:05,759
tears are welling up in my eyes because

103
00:05:09,409 --> 00:05:07,440
I'm just so

104
00:05:12,110 --> 00:05:09,419
reliving that moment that was so

105
00:05:15,290 --> 00:05:12,120
exciting and you may think after five of

106
00:05:17,930 --> 00:05:15,300
these now that it's less nerve-wracking

107
00:05:20,270 --> 00:05:17,940
every time but I I almost think it's the

108
00:05:21,770 --> 00:05:20,280
other way we you know when we were

109
00:05:23,870 --> 00:05:21,780
getting ready to land perseverance we

110
00:05:25,790 --> 00:05:23,880
were four for four for Rovers and we

111
00:05:27,290 --> 00:05:25,800
just know that Mars can always hand us

112
00:05:29,810 --> 00:05:27,300
something challenging so even though we

113
00:05:31,909 --> 00:05:29,820

were confident we were humble and as you

114

00:05:33,529 --> 00:05:31,919

can see it was a fantastic landing and

115

00:05:36,409 --> 00:05:33,539

for the very first time we were able to

116

00:05:38,150 --> 00:05:36,419

take images and video of the Rover and

117

00:05:40,550 --> 00:05:38,160

the parachute while we were landing and

118

00:05:43,070 --> 00:05:40,560

it's just some iconic images that we'll

119

00:05:45,830 --> 00:05:43,080

look at for years to come so a very

120

00:05:46,850 --> 00:05:45,840

exciting time but in addition to the

121

00:05:48,050 --> 00:05:46,860

successful Landing there are a couple

122

00:05:49,969 --> 00:05:48,060

other highlights I want to talk about

123

00:05:52,850 --> 00:05:49,979

Brian that's all right um the first one

124

00:05:55,129 --> 00:05:52,860

I want to mention is what you saw in

125

00:05:57,529 --> 00:05:55,139

that video it was a highlight for me to

126

00:06:00,350 --> 00:05:57,539

be able to share that success with

127

00:06:02,570 --> 00:06:00,360

people all over the world and the kids

128

00:06:04,909 --> 00:06:02,580

who were enjoying that it was wonderful

129

00:06:07,309 --> 00:06:04,919

we we saw those lights and play from

130

00:06:09,350 --> 00:06:07,319

places like France and Switzerland and a

131

00:06:11,930 --> 00:06:09,360

across the United States and here at

132

00:06:13,790 --> 00:06:11,940

home in La and I think for us it was

133

00:06:16,189 --> 00:06:13,800

also more special because

134

00:06:18,170 --> 00:06:16,199

the the time of the pandemic was really

135

00:06:19,969 --> 00:06:18,180

difficult for everyone it was difficult

136

00:06:22,790 --> 00:06:19,979

for our team it was difficult for all

137

00:06:25,909 --> 00:06:22,800

those people we really wanted to offer

138

00:06:28,490 --> 00:06:25,919

something exciting and hopeful and so

139

00:06:30,650 --> 00:06:28,500

the successful Landing it was thrilling

140

00:06:33,770 --> 00:06:30,660

for us to be able to share that success

141

00:06:36,290 --> 00:06:33,780

with all the people who were there with

142

00:06:38,930 --> 00:06:36,300

us and rooting us on and and really it's

143

00:06:40,490 --> 00:06:38,940

a true privilege to bring even just a

144

00:06:42,170 --> 00:06:40,500

little bit of Hope and joy and

145

00:06:43,850 --> 00:06:42,180

excitement to those who shared that

146

00:06:45,590 --> 00:06:43,860

Landing with us and and that was really

147

00:06:49,070 --> 00:06:45,600

a highlight for me so seeing that video

148

00:06:50,870 --> 00:06:49,080

again brings that all back to we're a

149

00:06:52,670 --> 00:06:50,880

team that operate and have developed

150

00:06:55,189 --> 00:06:52,680

their Rover on Mars but we're all a team

151
00:06:57,409 --> 00:06:55,199
who are looking and watching and and

152
00:06:59,629 --> 00:06:57,419
trying to understand more about Mars as

153
00:07:02,570 --> 00:06:59,639
we do this exploration

154
00:07:04,670 --> 00:07:02,580
and and then the other highlight I would

155
00:07:06,409 --> 00:07:04,680
say a lot has happened in that first

156
00:07:09,290 --> 00:07:06,419
year and Katie and I are going to go

157
00:07:11,210 --> 00:07:09,300
into more of those details but another

158
00:07:12,950 --> 00:07:11,220
highlight of the year and I've been the

159
00:07:16,550 --> 00:07:12,960
project manager for the last nine months

160
00:07:18,770 --> 00:07:16,560
is really just being a part of this

161
00:07:20,390 --> 00:07:18,780
perseverance team and if you come go to

162
00:07:22,790 --> 00:07:20,400
my next slide I want to I want to talk

163
00:07:26,089 --> 00:07:22,800

about something for just a minute in

164

00:07:29,390 --> 00:07:26,099

this image this is on the inside of the

165

00:07:32,330 --> 00:07:29,400

Rover's left wheel a front left wheel

166

00:07:35,450 --> 00:07:32,340

and what you see are at the bottom you

167

00:07:37,430 --> 00:07:35,460

can see this the white Treads of the

168

00:07:39,469 --> 00:07:37,440

Rover and what they would look like and

169

00:07:41,870 --> 00:07:39,479

what they do look like when we drive on

170

00:07:45,650 --> 00:07:41,880

the surface of Mars and above that you

171

00:07:47,930 --> 00:07:45,660

see those Treads Twisted into a DNA form

172

00:07:50,629 --> 00:07:47,940

and that's really to remind us of two

173

00:07:53,270 --> 00:07:50,639

things and the the first thing is that

174

00:07:56,629 --> 00:07:53,280

all of our robots are of human origin

175

00:07:59,330 --> 00:07:56,639

and the second thing is that the humans

176
00:08:02,270 --> 00:07:59,340
are the real explorers and speaking of

177
00:08:05,570 --> 00:08:02,280
human I want to bring up the next slide

178
00:08:08,150 --> 00:08:05,580
which shows just a small set of the

179
00:08:10,909 --> 00:08:08,160
thousands of people who have contributed

180
00:08:13,129 --> 00:08:10,919
to making this Mission successful and

181
00:08:14,990 --> 00:08:13,139
over the many years I've worked on these

182
00:08:17,749 --> 00:08:15,000
missions I've I become more and more

183
00:08:20,270 --> 00:08:17,759
aware of how every individual in this

184
00:08:22,969 --> 00:08:20,280
picture is actually uniquely gifted and

185
00:08:25,010 --> 00:08:22,979
can do amazing things but when groups of

186
00:08:27,589 --> 00:08:25,020
people like this come together and work

187
00:08:30,350 --> 00:08:27,599
cooperatively work collaboratively work

188
00:08:32,630 --> 00:08:30,360

with technical Excellence towards a

189

00:08:35,209 --> 00:08:32,640

common goal that's when you do the

190

00:08:37,370 --> 00:08:35,219

impossible and for me it's been the

191

00:08:40,310 --> 00:08:37,380

privilege of a lifetime to be a member

192

00:08:42,350 --> 00:08:40,320

of this team since 2015 and to now be

193

00:08:44,449 --> 00:08:42,360

leading the team as the project manager

194

00:08:46,970 --> 00:08:44,459

and the people that you see here they're

195

00:08:49,250 --> 00:08:46,980

my heroes they're my inspiration and

196

00:08:51,290 --> 00:08:49,260

they're really my lifelong friends so

197

00:08:52,550 --> 00:08:51,300

those are my highlights of the year

198

00:08:54,889 --> 00:08:52,560

Brian

199

00:08:56,329 --> 00:08:54,899

and very good highlights um something

200

00:08:59,150 --> 00:08:56,339

you've mentioned and you kind of you

201
00:09:01,070 --> 00:08:59,160
hinted at a little bit we've done you've

202
00:09:03,290 --> 00:09:01,080
done this five times

203
00:09:05,389 --> 00:09:03,300
um each particular Mission has its own

204
00:09:07,610 --> 00:09:05,399
Specialties but what are some challenges

205
00:09:09,050 --> 00:09:07,620
of this one in particular with

206
00:09:10,850 --> 00:09:09,060
everything that you kind of already know

207
00:09:12,829 --> 00:09:10,860
about Mars

208
00:09:14,630 --> 00:09:12,839
yeah well this was really challenging

209
00:09:17,269 --> 00:09:14,640
from both an engineering and a

210
00:09:19,070 --> 00:09:17,279
scientific point of view we we had to

211
00:09:21,530 --> 00:09:19,080
build a whole new sampling system that

212
00:09:24,710 --> 00:09:21,540
sampling system had to acquire Rock

213
00:09:27,410 --> 00:09:24,720

cores intact previously we had had a

214

00:09:29,449 --> 00:09:27,420

powdered core and then we had to store

215

00:09:31,490 --> 00:09:29,459

them for later return to Earth and that

216

00:09:33,829 --> 00:09:31,500

was a whole new challenge we had to

217

00:09:36,710 --> 00:09:33,839

develop a lot more hardware and then to

218

00:09:39,350 --> 00:09:36,720

top it off we had to do the mission at a

219

00:09:41,449 --> 00:09:39,360

pace in order to acquire three to four

220

00:09:44,210 --> 00:09:41,459

times more samples and Traverse three to

221

00:09:46,910 --> 00:09:44,220

four times faster than we ever had in

222

00:09:49,370 --> 00:09:46,920

previous missions in order to accomplish

223

00:09:51,230 --> 00:09:49,380

what a NASA headquarters set out for

224

00:09:52,850 --> 00:09:51,240

this Mission and get the science that we

225

00:09:54,829 --> 00:09:52,860

wanted to get so when I joined the

226

00:09:56,449 --> 00:09:54,839

project back in 2015 that was the first

227

00:10:00,170 --> 00:09:56,459

thing I started thinking about with the

228

00:10:02,329 --> 00:10:00,180

team how can we build this capability to

229

00:10:04,610 --> 00:10:02,339

get it was really 20 samples and 15

230

00:10:06,590 --> 00:10:04,620

kilometers in a three-year time frame on

231

00:10:09,710 --> 00:10:06,600

Mars and so one of the main things we

232

00:10:11,990 --> 00:10:09,720

did was we looked at where we could put

233

00:10:13,610 --> 00:10:12,000

significant autonomy enemy into the

234

00:10:15,290 --> 00:10:13,620

vehicle so it would be smarter it could

235

00:10:17,810 --> 00:10:15,300

do things on its own it didn't need

236

00:10:19,250 --> 00:10:17,820

Mission operations in the loop all the

237

00:10:20,690 --> 00:10:19,260

time to check things and make sure

238

00:10:22,430 --> 00:10:20,700

things were going right and so there are

239

00:10:25,069 --> 00:10:22,440

a couple areas I'll talk about where I

240

00:10:26,990 --> 00:10:25,079

feel like we've been very successful in

241

00:10:29,389 --> 00:10:27,000

the implementation of that autonomy and

242

00:10:32,210 --> 00:10:29,399

how it's played out on Mars so go ahead

243

00:10:35,210 --> 00:10:32,220

and start this next video the first area

244

00:10:37,069 --> 00:10:35,220

is sampling what we have is an

245

00:10:38,810 --> 00:10:37,079

end-to-end sampling system that can go

246

00:10:42,410 --> 00:10:38,820

from the beginning what you see here

247

00:10:44,870 --> 00:10:42,420

where the arm is moving out to place the

248

00:10:49,009 --> 00:10:44,880

core Earth our coring drill on the

249

00:10:51,069 --> 00:10:49,019

surface of Mars to take a rock core and

250

00:10:54,190 --> 00:10:51,079

place it in a tube the tube is actually

251
00:10:56,750 --> 00:10:54,200
inside the drill bit that you see there

252
00:10:59,569 --> 00:10:56,760
and this whole sequence that we're

253
00:11:02,569 --> 00:10:59,579
showing you happens end to end all in a

254
00:11:05,110 --> 00:11:02,579
single saw on Mars so we acquire the

255
00:11:08,389 --> 00:11:05,120
sample here you can now see the turret

256
00:11:09,829 --> 00:11:08,399
rotating bringing the core back to and

257
00:11:11,930 --> 00:11:09,839
docking with what we call our bit

258
00:11:14,630 --> 00:11:11,940
Carousel you you can see that's where we

259
00:11:16,550 --> 00:11:14,640
store the bits and then you can see that

260
00:11:18,769 --> 00:11:16,560
there's a whole nother robotic arm on

261
00:11:20,810 --> 00:11:18,779
the inside of the Rover this is our

262
00:11:23,870 --> 00:11:20,820
sample handling arm which takes the tube

263
00:11:26,930 --> 00:11:23,880

out of that bit and processes it and in

264

00:11:28,790 --> 00:11:26,940

the processing what we do is we take an

265

00:11:30,110 --> 00:11:28,800

image to make sure there's sample in the

266

00:11:32,930 --> 00:11:30,120

tube we'll talk about that a little

267

00:11:35,810 --> 00:11:32,940

later and we do a volume probe

268

00:11:39,110 --> 00:11:35,820

measurement and we seal it and store it

269

00:11:42,110 --> 00:11:39,120

for a subsequent placement on the

270

00:11:43,610 --> 00:11:42,120

surface of Mars for future pickup and

271

00:11:47,150 --> 00:11:43,620

then return to Earth

272

00:11:49,970 --> 00:11:47,160

so this entire activity is autonomous

273

00:11:52,610 --> 00:11:49,980

everything you saw here Percy will do on

274

00:11:54,829 --> 00:11:52,620

her own and the way we do that is we we

275

00:11:57,230 --> 00:11:54,839

have our flight software with a lot of

276

00:11:59,090 --> 00:11:57,240

algorithms and we have sensors like

277

00:12:01,670 --> 00:11:59,100

force sensors and temperature sensors

278

00:12:03,949 --> 00:12:01,680

and then safety limits so that so if

279

00:12:06,230 --> 00:12:03,959

Percy's on the right path she hasn't

280

00:12:08,269 --> 00:12:06,240

violated any of her safety limits she

281

00:12:10,250 --> 00:12:08,279

does it all by herself and if she's got

282

00:12:11,750 --> 00:12:10,260

a problem she'll phone home for help and

283

00:12:14,030 --> 00:12:11,760

and I'll tell you a little bit about

284

00:12:16,009 --> 00:12:14,040

that later too but many of our samples

285

00:12:17,690 --> 00:12:16,019

were acquired in a single song not all

286

00:12:20,210 --> 00:12:17,700

of them and so that's just been a real

287

00:12:21,290 --> 00:12:20,220

success story for perseverance this

288

00:12:23,090 --> 00:12:21,300

first year

289

00:12:26,269 --> 00:12:23,100

now the other area I want to talk about

290

00:12:28,730 --> 00:12:26,279

and this is this is really a a home run

291

00:12:30,710 --> 00:12:28,740

success story and we aren't even we're

292

00:12:32,150 --> 00:12:30,720

just I think just on the tip of the

293

00:12:33,470 --> 00:12:32,160

iceberg here for working what we're

294

00:12:36,110 --> 00:12:33,480

going to be able to do for autonomous

295

00:12:38,269 --> 00:12:36,120

navigation uh although um we had

296

00:12:40,850 --> 00:12:38,279

autonomous navigation on previous Rovers

297

00:12:42,889 --> 00:12:40,860

we actually did a major overhaul here we

298

00:12:44,629 --> 00:12:42,899

added another processor it was a

299

00:12:46,730 --> 00:12:44,639

processor that we used for the terrain

300

00:12:48,889 --> 00:12:46,740

relative navigation during entry descent

301
00:12:50,810 --> 00:12:48,899
and Landing we used that also on the

302
00:12:53,389 --> 00:12:50,820
surface for stereo image processing

303
00:12:55,190 --> 00:12:53,399
which speeds up the Rover's thinking

304
00:12:57,470 --> 00:12:55,200
quite a bit thinking about what the

305
00:13:00,230 --> 00:12:57,480
hazards are and making path paths and

306
00:13:02,690 --> 00:13:00,240
planning its paths but then we also

307
00:13:04,790 --> 00:13:02,700
changed the algorithm itself we had

308
00:13:06,710 --> 00:13:04,800
algorithms on previous Rovers that were

309
00:13:08,750 --> 00:13:06,720
highly conservative we wouldn't straddle

310
00:13:10,670 --> 00:13:08,760
a rock no matter the size we just

311
00:13:13,069 --> 00:13:10,680
wouldn't let a rock go under the belly

312
00:13:15,530 --> 00:13:13,079
pan things like that so we we changed

313
00:13:17,870 --> 00:13:15,540

the algorithm so that we were able to

314

00:13:20,509 --> 00:13:17,880

make more accurate maps and find more

315

00:13:22,430 --> 00:13:20,519

paths if you let your Rover drive over

316

00:13:25,129 --> 00:13:22,440

more rocks or are going to find more

317

00:13:27,230 --> 00:13:25,139

paths and be more successful so go ahead

318

00:13:29,990 --> 00:13:27,240

and cue and show the auto navigation

319

00:13:32,930 --> 00:13:30,000

video here's a our first record breaking

320

00:13:35,690 --> 00:13:32,940

out of navigation install this was saw

321

00:13:38,150 --> 00:13:35,700

200 this video Loops but what you're

322

00:13:41,090 --> 00:13:38,160

seeing are the images that the Rover

323

00:13:44,930 --> 00:13:41,100

took during autonomous navigation to

324

00:13:48,170 --> 00:13:44,940

decide where to drive the this is um

325

00:13:51,829 --> 00:13:48,180

sped up but the total distance we drove

326
00:13:55,009 --> 00:13:51,839
on the saw was 175 meters most of that

327
00:13:57,410 --> 00:13:55,019
was autonomous driving so what we've

328
00:13:59,870 --> 00:13:57,420
been able to do so far on perseverance

329
00:14:01,689 --> 00:13:59,880
is Drive about 100 meters per hour and

330
00:14:04,610 --> 00:14:01,699
if you compare that to previous missions

331
00:14:06,829 --> 00:14:04,620
the fastest we were ever able to go on

332
00:14:10,129 --> 00:14:06,839
curiosity your opportunity was less than

333
00:14:12,949 --> 00:14:10,139
25 meters per hour so we've quadrupled

334
00:14:16,250 --> 00:14:12,959
our our rate of reverse when we're in

335
00:14:17,990 --> 00:14:16,260
this autonomous mode on Mars and we just

336
00:14:19,970 --> 00:14:18,000
broke another record over Super Bowl

337
00:14:23,030 --> 00:14:19,980
weekend a good weekend to break a record

338
00:14:25,129 --> 00:14:23,040

we drove 305 49 yards

339

00:14:27,530 --> 00:14:25,139

I put it in yards because it happens to

340

00:14:29,930 --> 00:14:27,540

be more than either the Bengals or the

341

00:14:32,030 --> 00:14:29,940

Rams offenses got on that day so

342

00:14:34,310 --> 00:14:32,040

perseverance won the Super Bowl I don't

343

00:14:37,129 --> 00:14:34,320

know anyway I thought that was a fun our

344

00:14:39,470 --> 00:14:37,139

strategic Traverse planner Tyler Del

345

00:14:42,530 --> 00:14:39,480

cesto gave me that little tidbit which I

346

00:14:44,329 --> 00:14:42,540

just think is fun to talk about so

347

00:14:46,009 --> 00:14:44,339

um okay the Second Challenge I want to

348

00:14:49,370 --> 00:14:46,019

highlight is uh

349

00:14:51,050 --> 00:14:49,380

one that we have on every Mission and it

350

00:14:54,170 --> 00:14:51,060

sort of always manifests in a different

351
00:14:55,850 --> 00:14:54,180
way and it may sound simple but it's the

352
00:14:58,550 --> 00:14:55,860
fact that the challenge is Mars and

353
00:15:01,129 --> 00:14:58,560
being on Mars and this time it was Mars

354
00:15:04,250 --> 00:15:01,139
rocks not being exactly what we expected

355
00:15:06,290 --> 00:15:04,260
and interestingly on curiosity Mars

356
00:15:08,509 --> 00:15:06,300
rocks were also a challenge for us if

357
00:15:11,269 --> 00:15:08,519
you followed curiosity at all you'll

358
00:15:14,569 --> 00:15:11,279
remember we had some there were these

359
00:15:16,490 --> 00:15:14,579
very sharp small pointy rocks that you

360
00:15:18,050 --> 00:15:16,500
couldn't see from orbit but once we

361
00:15:20,150 --> 00:15:18,060
landed we realized that they were

362
00:15:21,949 --> 00:15:20,160
starting to poke holes in the wheels and

363
00:15:23,449 --> 00:15:21,959

so we had to be very careful about the

364

00:15:25,250 --> 00:15:23,459

way we Traverse still are very careful

365

00:15:26,269 --> 00:15:25,260

about the way we Traverse and curiosity

366

00:15:28,790 --> 00:15:26,279

so

367

00:15:30,590 --> 00:15:28,800

um Martian rocks are are prob not

368

00:15:33,110 --> 00:15:30,600

problem here but our another challenge

369

00:15:35,269 --> 00:15:33,120

we've had here the rocks that we found

370

00:15:37,430 --> 00:15:35,279

in jezero crater in the crater floor

371

00:15:39,949 --> 00:15:37,440

region where we are now so far they're

372

00:15:41,090 --> 00:15:39,959

very weathered they've um and so that

373

00:15:42,530 --> 00:15:41,100

means they're friable and they're

374

00:15:45,769 --> 00:15:42,540

Loosely Consolidated and they break

375

00:15:47,870 --> 00:15:45,779

apart and if you recall the very first

376

00:15:50,389 --> 00:15:47,880

time we tried to take a sampling a

377

00:15:53,329 --> 00:15:50,399

sample it was actually not successful so

378

00:15:55,189 --> 00:15:53,339

go ahead and bring up the next image of

379

00:15:57,230 --> 00:15:55,199

rubion this was our first sampling

380

00:16:00,290 --> 00:15:57,240

attempt on the right side here you'll

381

00:16:02,329 --> 00:16:00,300

see the at the top of the right side is

382

00:16:04,129 --> 00:16:02,339

an abraded patch we always abrid the

383

00:16:06,050 --> 00:16:04,139

rock to get under the surface place our

384

00:16:07,670 --> 00:16:06,060

science instruments on it make sure it's

385

00:16:10,009 --> 00:16:07,680

something that we want to take a sample

386

00:16:12,230 --> 00:16:10,019

of and they're to the lower right you

387

00:16:14,930 --> 00:16:12,240

see this beautiful borehole with a great

388

00:16:16,970 --> 00:16:14,940

tailings pile we woke up at 2 A.M we saw

389

00:16:20,030 --> 00:16:16,980

those images come down the Rover hadn't

390

00:16:22,069 --> 00:16:20,040

completed the rest of sampling but we

391

00:16:23,870 --> 00:16:22,079

went back to bed thinking okay all we

392

00:16:26,030 --> 00:16:23,880

have to do is come in at eight look at

393

00:16:28,249 --> 00:16:26,040

the the tube make sure there's a core in

394

00:16:30,110 --> 00:16:28,259

there and we were very comp I mean our

395

00:16:32,030 --> 00:16:30,120

hands were this far up in the air almost

396

00:16:33,470 --> 00:16:32,040

celebrating and then we saw the two

397

00:16:36,170 --> 00:16:33,480

images there that you see on the left

398

00:16:38,329 --> 00:16:36,180

the bottom one is the image that we take

399

00:16:40,670 --> 00:16:38,339

inside that adaptive caching assembly

400

00:16:42,170 --> 00:16:40,680

that we showed you in the video where we

401
00:16:43,610 --> 00:16:42,180
expect to see a core in there and you

402
00:16:45,350 --> 00:16:43,620
can see you see the bottom of the tube

403
00:16:47,509 --> 00:16:45,360
so there was nothing in the tube and

404
00:16:50,990 --> 00:16:47,519
then the top one is one that we take

405
00:16:52,610 --> 00:16:51,000
before we place the bit and tube in the

406
00:16:54,350 --> 00:16:52,620
bit Carousel and you can see the

407
00:16:56,030 --> 00:16:54,360
lighting was not great on that one but

408
00:16:58,430 --> 00:16:56,040
you can also see if you look carefully

409
00:17:00,829 --> 00:16:58,440
that there was not a core in there and

410
00:17:02,389 --> 00:17:00,839
so we you know we took our hands down

411
00:17:04,850 --> 00:17:02,399
grabbed our computers walked to the room

412
00:17:06,470 --> 00:17:04,860
tried to figure out what to do and um we

413
00:17:08,029 --> 00:17:06,480

did this we looked around to see if

414

00:17:09,710 --> 00:17:08,039

maybe we had dropped it we looked down

415

00:17:12,470 --> 00:17:09,720

in the hole to see if it was in the hole

416

00:17:14,750 --> 00:17:12,480

then we and eventually we did some

417

00:17:16,970 --> 00:17:14,760

testing on Earth and and realized that

418

00:17:19,370 --> 00:17:16,980

the percussive drill actually broke

419

00:17:21,110 --> 00:17:19,380

these rocks apart uh pulverized them

420

00:17:22,850 --> 00:17:21,120

during the percussion we we tried

421

00:17:24,230 --> 00:17:22,860

different experiments we found some

422

00:17:26,150 --> 00:17:24,240

rocks that we felt like were Martian

423

00:17:27,949 --> 00:17:26,160

analogs here and did some different

424

00:17:29,930 --> 00:17:27,959

experiments on Earth to see if we could

425

00:17:32,570 --> 00:17:29,940

reduce the percussion and be more

426
00:17:34,549 --> 00:17:32,580
successful but the Rocks also has some

427
00:17:36,710 --> 00:17:34,559
very hard parts so we weren't able to

428
00:17:39,590 --> 00:17:36,720
penetrate but the good news is we

429
00:17:41,390 --> 00:17:39,600
proceeded on with kind of collaboration

430
00:17:42,770 --> 00:17:41,400
with the science team for looking for a

431
00:17:45,350 --> 00:17:42,780
weathered rock that wasn't quite as

432
00:17:47,450 --> 00:17:45,360
weathered since then we've gotten six

433
00:17:49,070 --> 00:17:47,460
rock sample samples they're weathered

434
00:17:52,130 --> 00:17:49,080
but not quite as weathered as Ruby on

435
00:17:53,810 --> 00:17:52,140
and so that has been successful but that

436
00:17:56,150 --> 00:17:53,820
was a challenge and there was also

437
00:17:58,370 --> 00:17:56,160
another challenge very similar that that

438
00:18:00,470 --> 00:17:58,380

came from these Loosely Consolidated

439

00:18:03,049 --> 00:18:00,480

rocks back in January we spent a lot of

440

00:18:04,549 --> 00:18:03,059

January Happy New Years I think it was

441

00:18:06,650 --> 00:18:04,559

New Year's Day

442

00:18:09,409 --> 00:18:06,660

um we experienced another flavor of this

443

00:18:11,510 --> 00:18:09,419

issue and and as I described earlier if

444

00:18:14,150 --> 00:18:11,520

Percy's doing fine she keeps on going

445

00:18:15,890 --> 00:18:14,160

but if she has a problem she contacts

446

00:18:18,350 --> 00:18:15,900

the ground and so she contacted the

447

00:18:20,270 --> 00:18:18,360

ground when we had Corridor sample and

448

00:18:22,370 --> 00:18:20,280

we're getting ready and putting it into

449

00:18:23,990 --> 00:18:22,380

that bit Carousel where we take the tube

450

00:18:26,870 --> 00:18:24,000

in the bit and we place it in there into

451
00:18:29,150 --> 00:18:26,880
this thing called a bit sleeve when it

452
00:18:30,950 --> 00:18:29,160
was doing that it sent an error message

453
00:18:32,090 --> 00:18:30,960
down saying it got to the force we were

454
00:18:33,830 --> 00:18:32,100
looking for but it was about a

455
00:18:37,310 --> 00:18:33,840
centimeter short of the place we wanted

456
00:18:40,250 --> 00:18:37,320
to push that bit into and so you go

457
00:18:42,890 --> 00:18:40,260
ahead and bring up the next image so

458
00:18:44,810 --> 00:18:42,900
what you can see here on the left is a

459
00:18:47,330 --> 00:18:44,820
bit sleeve where we were trying to push

460
00:18:50,510 --> 00:18:47,340
that bit with tube in it into and you

461
00:18:52,490 --> 00:18:50,520
can see two Pebbles down there and then

462
00:18:55,070 --> 00:18:52,500
on the right you can see two Pebbles

463
00:18:56,750 --> 00:18:55,080

kind of in the middle of that image and

464

00:18:59,090 --> 00:18:56,760

that is actually sitting on the rotor

465

00:19:01,669 --> 00:18:59,100

the bit Carousel so we had pebbles in

466

00:19:03,289 --> 00:19:01,679

the system we were relieved to see those

467

00:19:05,029 --> 00:19:03,299

images we didn't actually know what it

468

00:19:06,770 --> 00:19:05,039

was initially what was causing the

469

00:19:09,049 --> 00:19:06,780

problem we were relieved to see the

470

00:19:11,270 --> 00:19:09,059

images because we at least knew what was

471

00:19:13,370 --> 00:19:11,280

wrong I think we knew that we had to

472

00:19:14,990 --> 00:19:13,380

carefully get those Pebbles out of there

473

00:19:17,390 --> 00:19:15,000

so that they didn't jam up the bit

474

00:19:20,029 --> 00:19:17,400

Carousel in any way so what we ended up

475

00:19:22,850 --> 00:19:20,039

doing is for the top Pebbles we were

476

00:19:24,409 --> 00:19:22,860

able to get those out by using the

477

00:19:26,029 --> 00:19:24,419

percussive drill just to put some

478

00:19:27,770 --> 00:19:26,039

Dynamics into the vehicle and then we

479

00:19:30,470 --> 00:19:27,780

moved the bit Carousel and those popped

480

00:19:32,510 --> 00:19:30,480

out and then on the the Pebbles on the

481

00:19:34,970 --> 00:19:32,520

right we drove the Rover and those came

482

00:19:38,390 --> 00:19:34,980

out as well so there's always a fun

483

00:19:40,070 --> 00:19:38,400

problem to solve on Mars but we were

484

00:19:43,730 --> 00:19:40,080

able to do that and now we're basically

485

00:19:45,350 --> 00:19:43,740

on our way we're moving now we're on the

486

00:19:46,510 --> 00:19:45,360

road and if you go ahead and bring up

487

00:19:49,850 --> 00:19:46,520

the next

488

00:19:51,950 --> 00:19:49,860

image right after we we in fact on that

489

00:19:53,810 --> 00:19:51,960

last one we went and we did get a core

490

00:19:55,610 --> 00:19:53,820

from that rock we dumped out the core

491

00:19:56,990 --> 00:19:55,620

that had gotten Pebbles dropped in the

492

00:19:59,870 --> 00:19:57,000

bit Carousel we got a core and then

493

00:20:01,370 --> 00:19:59,880

we're moving along an area called artubi

494

00:20:02,990 --> 00:20:01,380

Ridge and you can see that Ridge there

495

00:20:04,789 --> 00:20:03,000

and then you can see the sand dunes in

496

00:20:06,770 --> 00:20:04,799

the middle and you see the rover robotic

497

00:20:08,750 --> 00:20:06,780

arm and the in the foreground of the

498

00:20:11,570 --> 00:20:08,760

image and if you look carefully you'll

499

00:20:13,490 --> 00:20:11,580

see an abraded patch that we did here as

500

00:20:15,470 --> 00:20:13,500

we're moving back to The Landing site to

501
00:20:17,690 --> 00:20:15,480
get kind of the final samples for this

502
00:20:20,450 --> 00:20:17,700
area this science campaign that Katie

503
00:20:22,669 --> 00:20:20,460
will talk about we did an abrasion here

504
00:20:24,470 --> 00:20:22,679
just to see if this was the same kind of

505
00:20:28,130 --> 00:20:24,480
rock and give us more information for

506
00:20:29,930 --> 00:20:28,140
the context of the region

507
00:20:32,029 --> 00:20:29,940
very cool

508
00:20:33,649 --> 00:20:32,039
um there's so much I mean there's just

509
00:20:35,630 --> 00:20:33,659
so much and I know we can't even get all

510
00:20:37,070 --> 00:20:35,640
of it into this talk today

511
00:20:39,289 --> 00:20:37,080
um so we're talking about excitement

512
00:20:40,730 --> 00:20:39,299
we're talking about challenges what are

513
00:20:42,710 --> 00:20:40,740

some of the things that we've learned

514

00:20:44,690 --> 00:20:42,720

operating and how does that affect where

515

00:20:46,850 --> 00:20:44,700

we go next

516

00:20:48,049 --> 00:20:46,860

yeah well I would say I've been on five

517

00:20:51,770 --> 00:20:48,059

of these I know I've said that a lot of

518

00:20:53,810 --> 00:20:51,780

times but this Rover is solid it's a

519

00:20:56,630 --> 00:20:53,820

great Rover it's well built it's well

520

00:20:58,789 --> 00:20:56,640

tested in general it executes with

521

00:21:01,190 --> 00:20:58,799

perfection the things that we ask it to

522

00:21:02,930 --> 00:21:01,200

do this of course is largely due to

523

00:21:04,789 --> 00:21:02,940

those people I showed you earlier who

524

00:21:07,430 --> 00:21:04,799

built it and tested it and continue to

525

00:21:09,169 --> 00:21:07,440

operate it as well as I think the legacy

526
00:21:11,690 --> 00:21:09,179
of the teams and the people who came

527
00:21:12,950 --> 00:21:11,700
before us we've just been learning and

528
00:21:15,590 --> 00:21:12,960
learning and getting better at this

529
00:21:18,590 --> 00:21:15,600
being more prepared and so far the only

530
00:21:20,990 --> 00:21:18,600
times we've really had problems were

531
00:21:24,010 --> 00:21:21,000
when Mars gave us something a little

532
00:21:26,690 --> 00:21:24,020
unexpected so because of this

533
00:21:29,029 --> 00:21:26,700
we will continue to push the envelope

534
00:21:31,730 --> 00:21:29,039
with this Rover and this Mission and

535
00:21:34,669 --> 00:21:31,740
that includes still regularly using

536
00:21:36,830 --> 00:21:34,679
Ingenuity to support scouting we're

537
00:21:39,830 --> 00:21:36,840
adding more autonomy to the vehicle and

538
00:21:42,409 --> 00:21:39,840

our next big exploration is of the Delta

539

00:21:44,330 --> 00:21:42,419

the delta in the crater that is the area

540

00:21:47,210 --> 00:21:44,340

where we expect to find the sedimentary

541

00:21:48,590 --> 00:21:47,220

Iraq and uh in getting there we really

542

00:21:52,370 --> 00:21:48,600

have the opportunity to hit the

543

00:21:54,529 --> 00:21:52,380

interstate between here and uh the Delta

544

00:21:56,390 --> 00:21:54,539

and we'll really see what our updated

545

00:21:58,370 --> 00:21:56,400

autonomous navigation capabilities can

546

00:22:00,470 --> 00:21:58,380

do and I expect we'll be breaking more

547

00:22:02,230 --> 00:22:00,480

records so let me show you this next

548

00:22:04,850 --> 00:22:02,240

image which

549

00:22:07,549 --> 00:22:04,860

shows you the Traverse so the Green Path

550

00:22:09,529 --> 00:22:07,559

is the green is where we are we actually

551
00:22:11,990 --> 00:22:09,539
if you can see the sand there's a thumb

552
00:22:13,730 --> 00:22:12,000
which is sort of a sand area called Sita

553
00:22:16,490 --> 00:22:13,740
down there and and we went all the way

554
00:22:18,529 --> 00:22:16,500
up to the the other part of the thumb

555
00:22:19,850 --> 00:22:18,539
that doesn't have the Green Path and now

556
00:22:22,669 --> 00:22:19,860
we're back down to where the green pass

557
00:22:26,029 --> 00:22:22,679
starts it's about a kilometer back to

558
00:22:27,830 --> 00:22:26,039
the uh Landing region where we'll take

559
00:22:30,890 --> 00:22:27,840
the other samples and then another five

560
00:22:32,570 --> 00:22:30,900
kilometers over to the Delta and we hope

561
00:22:34,789 --> 00:22:32,580
to arrive there expect to arrive there

562
00:22:38,029 --> 00:22:34,799
in late spring and of course our main

563
00:22:40,490 --> 00:22:38,039

goal here is to Cache these samples for

564

00:22:44,090 --> 00:22:40,500

future return to Earth and our initial

565

00:22:46,850 --> 00:22:44,100

caching Depot will possibly be somewhere

566

00:22:49,310 --> 00:22:46,860

in this map maybe on top of the Delta so

567

00:22:51,529 --> 00:22:49,320

a little bit off the map or it may it's

568

00:22:53,810 --> 00:22:51,539

equally likely that it would be further

569

00:22:56,149 --> 00:22:53,820

even towards the edge of the crater when

570

00:22:59,390 --> 00:22:56,159

we're ready to deposit that initial set

571

00:23:01,490 --> 00:22:59,400

of samples so we have tons of excitement

572

00:23:03,710 --> 00:23:01,500

ahead on the mission and we hope you'll

573

00:23:06,049 --> 00:23:03,720

continue to follow us and and join us

574

00:23:07,669 --> 00:23:06,059

and all this excitement

575

00:23:09,529 --> 00:23:07,679

well we've got a lot of people following

576

00:23:10,730 --> 00:23:09,539

tonight which is wonderful so we're

577

00:23:12,289 --> 00:23:10,740

going to bring in one of your the

578

00:23:14,029 --> 00:23:12,299

audience questions now and then we're

579

00:23:15,529 --> 00:23:14,039

going to go talk to Katie for a little

580

00:23:17,510 --> 00:23:15,539

bit and then we'll bring everybody back

581

00:23:19,610 --> 00:23:17,520

so for some more q a at the end so Nikki

582

00:23:21,590 --> 00:23:19,620

what are they asking right now

583

00:23:23,149 --> 00:23:21,600

yeah so Jennifer you've talked a lot

584

00:23:25,130 --> 00:23:23,159

about some of the great things that have

585

00:23:27,770 --> 00:23:25,140

gone on and how you've worked on several

586

00:23:29,890 --> 00:23:27,780

of these Rovers and Tony orange is on

587

00:23:32,390 --> 00:23:29,900

YouTube wants to ask you two questions

588

00:23:35,990 --> 00:23:32,400

what new upgrades would you want to see

589

00:23:37,789 --> 00:23:36,000

on future Rovers on Mars and also how

590

00:23:41,510 --> 00:23:37,799

many years can the perseverance Rover

591

00:23:44,510 --> 00:23:41,520

survive doing science on Mars

592

00:23:47,210 --> 00:23:44,520

okay I'll start with the second one it's

593

00:23:49,730 --> 00:23:47,220

actually not an easier one but it's a

594

00:23:51,830 --> 00:23:49,740

it's one where we we build the hardware

595

00:23:54,110 --> 00:23:51,840

it has sort of a warranty just like your

596

00:23:56,630 --> 00:23:54,120

car has a warranty uh for about three

597

00:23:58,490 --> 00:23:56,640

years we test it all three years but we

598

00:24:01,310 --> 00:23:58,500

have enough energy we expect the

599

00:24:03,590 --> 00:24:01,320

hardware uh to work a lot longer you can

600

00:24:05,450 --> 00:24:03,600

see with curiosity and with spirit and

601
00:24:08,570 --> 00:24:05,460
opportunity all of our Rovers have

602
00:24:10,490 --> 00:24:08,580
outlived their lifetime so the three

603
00:24:12,470 --> 00:24:10,500
years is when the warranty expires but

604
00:24:15,289 --> 00:24:12,480
we expect it to live quite a bit longer

605
00:24:17,930 --> 00:24:15,299
we're confident of that but we're also

606
00:24:20,390 --> 00:24:17,940
um we're also humble about the fact that

607
00:24:23,450 --> 00:24:20,400
you know different things can happen so

608
00:24:25,130 --> 00:24:23,460
we hope to have it you know live a

609
00:24:26,870 --> 00:24:25,140
decade or longer just like opportunity

610
00:24:29,330 --> 00:24:26,880
those are great great

611
00:24:31,669 --> 00:24:29,340
missions and as far as things I would

612
00:24:34,850 --> 00:24:31,679
like to see I always when I very first

613
00:24:37,970 --> 00:24:34,860

started this mission in 2015

614

00:24:39,529 --> 00:24:37,980

because we had this autonomy Focus I

615

00:24:42,289 --> 00:24:39,539

remember going into the conference room

616

00:24:44,930 --> 00:24:42,299

with the team and I said we we got it we

617

00:24:46,430 --> 00:24:44,940

can't we can't just you know code this

618

00:24:48,049 --> 00:24:46,440

thing from the ground which is sort of

619

00:24:49,610 --> 00:24:48,059

what we do we write our sequences and

620

00:24:51,830 --> 00:24:49,620

send them up every day we need this

621

00:24:53,750 --> 00:24:51,840

thing to be more autonomous and I I put

622

00:24:55,490 --> 00:24:53,760

my feet up on the table and I said

623

00:24:58,310 --> 00:24:55,500

here's what I want and I pushed the

624

00:25:01,190 --> 00:24:58,320

button and I said do a great science

625

00:25:03,590 --> 00:25:01,200

Mission and it'll be done right and and

626

00:25:06,110 --> 00:25:03,600

so we're not anywhere really close to

627

00:25:08,750 --> 00:25:06,120

that but getting the Rovers a tonboard

628

00:25:10,909 --> 00:25:08,760

autonomy onboard sensing so that it can

629

00:25:13,850 --> 00:25:10,919

choose its own science targets we we're

630

00:25:15,769 --> 00:25:13,860

toe dipping into that one uh I think we

631

00:25:17,870 --> 00:25:15,779

still autonomous navigation is very fast

632

00:25:19,549 --> 00:25:17,880

but it is not quite at the limit of what

633

00:25:21,769 --> 00:25:19,559

the wheels could drive so we could still

634

00:25:23,690 --> 00:25:21,779

drive faster our next missions are

635

00:25:25,850 --> 00:25:23,700

getting really close to Pinpoint Landing

636

00:25:27,289 --> 00:25:25,860

so that's a great one but then just this

637

00:25:29,210 --> 00:25:27,299

idea that the

638

00:25:31,610 --> 00:25:29,220

Percy figures out what she wants to do

639

00:25:33,590 --> 00:25:31,620

every day to accomplish the science

640

00:25:36,830 --> 00:25:33,600

mission that we've given her so

641

00:25:38,930 --> 00:25:36,840

those are my dreams

642

00:25:40,730 --> 00:25:38,940

what a great setup and a great

643

00:25:43,010 --> 00:25:40,740

introduction to our next speaker

644

00:25:45,529 --> 00:25:43,020

Jennifer will bring you back in a little

645

00:25:47,690 --> 00:25:45,539

bit but our next speaker graduated with

646

00:25:49,310 --> 00:25:47,700

a ba in geology an astronomy for

647

00:25:52,669 --> 00:25:49,320

Williams College from Williams college

648

00:25:55,430 --> 00:25:52,679

and earn her MSC and her PhD in geology

649

00:25:56,990 --> 00:25:55,440

from Caltech Katie's research focuses on

650

00:25:59,750 --> 00:25:57,000

the Martian sedimentary rock record

651
00:26:01,610 --> 00:25:59,760
using Orbiter and Rover image data to

652
00:26:04,430 --> 00:26:01,620
understand the evolution of ancient

653
00:26:06,169 --> 00:26:04,440
surface processes on Mars she is a

654
00:26:08,450 --> 00:26:06,179
research scientist here at JPL a

655
00:26:10,970 --> 00:26:08,460
participating scientist on the Mars

656
00:26:13,730 --> 00:26:10,980
science laboratory Curiosity Rover and

657
00:26:16,190 --> 00:26:13,740
the deputy project scientist of the Mars

658
00:26:19,850 --> 00:26:16,200
2020 perseverance Rover please welcome

659
00:26:21,769 --> 00:26:19,860
Dr Katie stack Morgan hi you Katie

660
00:26:23,330 --> 00:26:21,779
hi Brian

661
00:26:25,250 --> 00:26:23,340
so much great stuff we've talked about

662
00:26:28,149 --> 00:26:25,260
so far but one we haven't really talked

663
00:26:31,490 --> 00:26:28,159

about yet is why Mars

664

00:26:34,610 --> 00:26:31,500

yeah so the Mars we know today is a

665

00:26:36,830 --> 00:26:34,620

Barren dry very cold landscape not

666

00:26:39,470 --> 00:26:36,840

particularly hospitable to Life as We

667

00:26:41,390 --> 00:26:39,480

Know It uh but we know based on our

668

00:26:43,250 --> 00:26:41,400

observations of Mars from Rovers and

669

00:26:45,289 --> 00:26:43,260

orbiters that Mars wasn't always like

670

00:26:48,769 --> 00:26:45,299

that and and Mars was once very

671

00:26:51,649 --> 00:26:48,779

Earth-like and we think that

672

00:26:54,769 --> 00:26:51,659

you know there's a good chance that Mars

673

00:26:56,930 --> 00:26:54,779

was capable of supporting life just like

674

00:26:59,510 --> 00:26:56,940

early Earth was and the period of time

675

00:27:01,669 --> 00:26:59,520

when Mars we think was once habitable

676
00:27:04,549 --> 00:27:01,679
was the same time that life was emerging

677
00:27:06,470 --> 00:27:04,559
on our own planet and so we think Mars

678
00:27:08,450 --> 00:27:06,480
is a really attractive place to go to

679
00:27:10,430 --> 00:27:08,460
look for signs of ancient life and

680
00:27:12,350 --> 00:27:10,440
perhaps the best place in the solar

681
00:27:14,149 --> 00:27:12,360
system to look for signs of ancient life

682
00:27:15,950 --> 00:27:14,159
and every rover mission we've sent to

683
00:27:17,990 --> 00:27:15,960
Mars has found and discovered and

684
00:27:20,090 --> 00:27:18,000
explored habitable ancient environments

685
00:27:22,430 --> 00:27:20,100
and so we think Mars is really a great

686
00:27:25,370 --> 00:27:22,440
place to go to look for signs of life

687
00:27:26,930 --> 00:27:25,380
beyond our own planet and you know the

688
00:27:29,450 --> 00:27:26,940

really neat thing and fascinating thing

689

00:27:31,370 --> 00:27:29,460

about studying Mars is that in some ways

690

00:27:33,110 --> 00:27:31,380

it is so familiar particularly when we

691

00:27:35,210 --> 00:27:33,120

look at ancient rocks and we recognize

692

00:27:37,430 --> 00:27:35,220

the kind of environments that we know

693

00:27:39,710 --> 00:27:37,440

and see here on our own Planet yet this

694

00:27:42,529 --> 00:27:39,720

is another planet and it took a very

695

00:27:44,570 --> 00:27:42,539

different path over time to look the way

696

00:27:47,149 --> 00:27:44,580

it does now and so there is still

697

00:27:49,370 --> 00:27:47,159

something alien about it and so it's

698

00:27:51,230 --> 00:27:49,380

this combination of the familiar and the

699

00:27:53,149 --> 00:27:51,240

unfamiliar and that makes Mars such a

700

00:27:55,070 --> 00:27:53,159

fascinating place to look at and to

701
00:27:57,289 --> 00:27:55,080
study and to understand

702
00:27:58,789 --> 00:27:57,299
so let's then let's keep going in a

703
00:28:01,010 --> 00:27:58,799
little further that's a great

704
00:28:03,230 --> 00:28:01,020
explanation on Mars so then why jezero

705
00:28:04,909 --> 00:28:03,240
crater and specifically

706
00:28:07,549 --> 00:28:04,919
yes if we could bring it bring up slide

707
00:28:11,090 --> 00:28:07,559
10 and we'll see a view of jezero Crater

708
00:28:12,830 --> 00:28:11,100
from an Orbiter perspective and jezra

709
00:28:15,049 --> 00:28:12,840
was selected as the landing site for the

710
00:28:17,930 --> 00:28:15,059
Mars 2020 perseverance Rover and this

711
00:28:19,850 --> 00:28:17,940
site really has it all it has habitable

712
00:28:21,710 --> 00:28:19,860
environments both preserved at the

713
00:28:24,590 --> 00:28:21,720

surface and we think in the near

714

00:28:26,750 --> 00:28:24,600

subsurface we have of course the Delta

715

00:28:28,549 --> 00:28:26,760

that's the main target of the mission we

716

00:28:30,470 --> 00:28:28,559

have some interesting units along the

717

00:28:32,690 --> 00:28:30,480

inner margin of the crater and perhaps

718

00:28:34,789 --> 00:28:32,700

even some habitable ancient environments

719

00:28:36,409 --> 00:28:34,799

in the Rocks themselves maybe the Crater

720

00:28:39,529 --> 00:28:36,419

Rim and and the rocks of the crater

721

00:28:42,409 --> 00:28:39,539

floor we also have a diversity of

722

00:28:43,970 --> 00:28:42,419

minerals here in this location uh

723

00:28:47,570 --> 00:28:43,980

suggesting a variety of different

724

00:28:49,430 --> 00:28:47,580

processes occurred at this one site and

725

00:28:52,430 --> 00:28:49,440

also this this site has the element of

726

00:28:55,310 --> 00:28:52,440

time the roxier record hundreds of

727

00:28:57,110 --> 00:28:55,320

millions of years and and give us an

728

00:29:00,110 --> 00:28:57,120

opportunity with a single Rover to

729

00:29:01,430 --> 00:29:00,120

explore a big period of time in Mars

730

00:29:04,370 --> 00:29:01,440

history and and so when we look at

731

00:29:06,409 --> 00:29:04,380

images like this we see a landscape

732

00:29:08,330 --> 00:29:06,419

Frozen in time but to really bring this

733

00:29:10,149 --> 00:29:08,340

to life for you all I want to bring up

734

00:29:12,889 --> 00:29:10,159

the the next video I think it's video 11

735

00:29:15,529 --> 00:29:12,899

uh to really bring this to life and show

736

00:29:17,690 --> 00:29:15,539

us how this site came to be so here we

737

00:29:19,370 --> 00:29:17,700

are 3.8 billion years ago and we're

738

00:29:21,830 --> 00:29:19,380

about to see the impactor that is going

739

00:29:24,590 --> 00:29:21,840

to create Jezreel crater so here it is

740

00:29:26,810 --> 00:29:24,600

speeding towards the surface and boom we

741

00:29:29,090 --> 00:29:26,820

have jezre crater formed

742

00:29:32,210 --> 00:29:29,100

um quite a catastrophic event perhaps at

743

00:29:34,250 --> 00:29:32,220

a time when we had water on the surface

744

00:29:37,909 --> 00:29:34,260

um so here we have Jezreel crater it is

745

00:29:39,950 --> 00:29:37,919

it is now here in this landscape and

746

00:29:41,570 --> 00:29:39,960

what we see now is we know based on what

747

00:29:44,450 --> 00:29:41,580

we see from orbit and now on the ground

748

00:29:47,029 --> 00:29:44,460

that water rushed into this Crater from

749

00:29:49,490 --> 00:29:47,039

uh at least a couple channels on the the

750

00:29:50,810 --> 00:29:49,500

crater walls and here we see it filling

751
00:29:53,149 --> 00:29:50,820

up and we have

752
00:29:55,490 --> 00:29:53,159

conclusive evidence that this crater did

753
00:29:58,250 --> 00:29:55,500

indeed fill up all the way to the brim

754
00:29:59,810 --> 00:29:58,260

and we know that it actually overflowed

755
00:30:01,490 --> 00:29:59,820

and there aren't that many craters on

756
00:30:03,230 --> 00:30:01,500

Mars where we can say that and so we

757
00:30:05,810 --> 00:30:03,240

know that there was water in this crater

758
00:30:07,730 --> 00:30:05,820

for geologically significant amounts of

759
00:30:09,769 --> 00:30:07,740

time and here we see that outflow

760
00:30:11,570 --> 00:30:09,779

channel and as we zoom in here we're

761
00:30:14,210 --> 00:30:11,580

going to see over time of course that

762
00:30:16,909 --> 00:30:14,220

Lake dried up it disappeared and

763
00:30:19,010 --> 00:30:16,919

eventually it leaves us with the fossil

764

00:30:22,789 --> 00:30:19,020

landscape that we have to explore with

765

00:30:28,130 --> 00:30:25,490

that's I I just love that animation

766

00:30:30,710 --> 00:30:28,140

that's so cool the main question we're

767

00:30:32,269 --> 00:30:30,720

getting a lot right now on through our

768

00:30:34,669 --> 00:30:32,279

chats and our audience watching at home

769

00:30:36,350 --> 00:30:34,679

is what are the biggest surprises that

770

00:30:37,490 --> 00:30:36,360

we've gotten from this first year on

771

00:30:40,070 --> 00:30:37,500

Mars

772

00:30:42,950 --> 00:30:40,080

yeah and this is a great question for me

773

00:30:45,049 --> 00:30:42,960

because I and and many scientists who've

774

00:30:47,389 --> 00:30:45,059

thought about Landing sites on Mars we

775

00:30:50,330 --> 00:30:47,399

spend years pouring over those Orbiter

776

00:30:52,669 --> 00:30:50,340

images trying to to guess what's there

777

00:30:54,830 --> 00:30:52,679

and try to interpret what's there

778

00:30:55,970 --> 00:30:54,840

um and so going into this Mission I

779

00:30:57,470 --> 00:30:55,980

thought you know I've thought of all the

780

00:30:58,549 --> 00:30:57,480

possibilities and it's going to be one

781

00:30:59,630 --> 00:30:58,559

of those things that I've thought about

782

00:31:02,029 --> 00:30:59,640

and that's how we're going to explain

783

00:31:04,430 --> 00:31:02,039

the Rocks but of course Mars throws us

784

00:31:06,470 --> 00:31:04,440

surprises and we certainly had that uh

785

00:31:08,870 --> 00:31:06,480

one thing thankfully was not a surprise

786

00:31:11,029 --> 00:31:08,880

and if we bring up slide 12

787

00:31:12,950 --> 00:31:11,039

um we thought from orbit that there was

788

00:31:15,110 --> 00:31:12,960

a lake and a Delta and you just saw that

789

00:31:17,509 --> 00:31:15,120

in in the video and when we got in the

790

00:31:19,909 --> 00:31:17,519

ground and we imaged towards the Delta

791

00:31:21,830 --> 00:31:19,919

deposit we saw this beautiful outcrop

792

00:31:24,049 --> 00:31:21,840

and this is the kind of outcrop that you

793

00:31:26,690 --> 00:31:24,059

would bring a geology class on Earth to

794

00:31:29,330 --> 00:31:26,700

teach them about deltas this is classic

795

00:31:31,669 --> 00:31:29,340

Delta stratigraphy and you see the

796

00:31:33,409 --> 00:31:31,679

layers in this image the flat layers on

797

00:31:35,750 --> 00:31:33,419

top represent the upper part of the

798

00:31:37,850 --> 00:31:35,760

Delta going into those dipping beds as

799

00:31:39,710 --> 00:31:37,860

you get into the lake and then as you

800

00:31:41,630 --> 00:31:39,720

get into those flat beds at the bottom

801
00:31:44,269 --> 00:31:41,640
that's really those are the layers that

802
00:31:46,009 --> 00:31:44,279
we look at for signs of preserved

803
00:31:48,710 --> 00:31:46,019
Organics and possible signs of Life

804
00:31:50,509 --> 00:31:48,720
concentrated there in the the distal

805
00:31:53,029 --> 00:31:50,519
Parts the distant parts of these Lake

806
00:31:54,950 --> 00:31:53,039
deposits and so we were relieved that

807
00:31:56,930 --> 00:31:54,960
this was not a surprise there is indeed

808
00:31:59,330 --> 00:31:56,940
a Delta we have confirmed it and we have

809
00:32:01,009 --> 00:31:59,340
beautiful outcrops to show that we have

810
00:32:03,049 --> 00:32:01,019
this habitable service environment

811
00:32:04,669 --> 00:32:03,059
preserved in Jezreel but there were

812
00:32:07,549 --> 00:32:04,679
still surprises in stores so if we bring

813
00:32:09,230 --> 00:32:07,559

up the next Slide the slide 13. while we

814

00:32:10,909 --> 00:32:09,240

knew there was a lake and a Delta here

815

00:32:13,970 --> 00:32:10,919

in Jezreel one thing we weren't

816

00:32:16,669 --> 00:32:13,980

expecting was signs of pretty active

817

00:32:17,810 --> 00:32:16,679

high energy flood deposits and so that's

818

00:32:20,389 --> 00:32:17,820

what we're seeing here this is an

819

00:32:22,789 --> 00:32:20,399

outcrop from the front of the Delta and

820

00:32:25,190 --> 00:32:22,799

that Arrow there points to a big boulder

821

00:32:27,830 --> 00:32:25,200

and that's in almost one meter wide

822

00:32:29,630 --> 00:32:27,840

Boulder and so in order to transport a

823

00:32:31,549 --> 00:32:29,640

boulder like that and the boulders in

824

00:32:33,769 --> 00:32:31,559

the the surrounding outcrop you need

825

00:32:35,870 --> 00:32:33,779

pretty high energy energetic floods

826

00:32:37,909 --> 00:32:35,880

coming into the crater and so we didn't

827

00:32:40,190 --> 00:32:37,919

know that that was happening here in

828

00:32:41,810 --> 00:32:40,200

Jezreel so we think we had this Lake and

829

00:32:43,970 --> 00:32:41,820

this Delta setting that transitioned

830

00:32:46,310 --> 00:32:43,980

over time into something much more

831

00:32:48,889 --> 00:32:46,320

energetic and perhaps catastrophic and

832

00:32:51,529 --> 00:32:48,899

that might have been how water had its

833

00:32:54,529 --> 00:32:51,539

last gasp here in Jezreel crater

834

00:32:57,350 --> 00:32:54,539

um if we bring up the next slide

835

00:32:59,210 --> 00:32:57,360

um while we had views of the Delta

836

00:33:00,889 --> 00:32:59,220

um when we landed at Octavia E Butler

837

00:33:03,049 --> 00:33:00,899

Landing seen here again in the Orbiter

838

00:33:05,389 --> 00:33:03,059

image we actually landed on the rocks of

839

00:33:08,210 --> 00:33:05,399

the Jezreel crater floor and we weren't

840

00:33:10,070 --> 00:33:08,220

sure what to expect of these rocks there

841

00:33:12,710 --> 00:33:10,080

were different hypotheses thrown out by

842

00:33:16,190 --> 00:33:12,720

scientists are they igneous or volcanic

843

00:33:18,350 --> 00:33:16,200

rocks formed from magma or or lava flows

844

00:33:20,690 --> 00:33:18,360

or were they sedimentary rocks after all

845

00:33:22,909 --> 00:33:20,700

we are in a sedimentary Basin where we

846

00:33:24,409 --> 00:33:22,919

knew a lake was present and so we have

847

00:33:26,450 --> 00:33:24,419

this question and in this case the

848

00:33:28,310 --> 00:33:26,460

Orbiter data doesn't tell you very it

849

00:33:29,750 --> 00:33:28,320

doesn't tell you the whole story so we

850

00:33:31,370 --> 00:33:29,760

went into this thinking you know you

851

00:33:32,750 --> 00:33:31,380

could probably split the the team in

852

00:33:34,370 --> 00:33:32,760

half those who thought it was going to

853

00:33:35,509 --> 00:33:34,380

be were going to be igneous and those

854

00:33:37,789 --> 00:33:35,519

who thought the Rocks were going to be

855

00:33:39,350 --> 00:33:37,799

sedimentary so the first couple of of

856

00:33:41,090 --> 00:33:39,360

months of the mission we were left

857

00:33:43,549 --> 00:33:41,100

scratching our heads about this this

858

00:33:45,950 --> 00:33:43,559

question uh the Rocks weren't giving us

859

00:33:47,930 --> 00:33:45,960

many Clues they were Dusty their natural

860

00:33:50,269 --> 00:33:47,940

surfaces were obscuring the kind of

861

00:33:52,430 --> 00:33:50,279

textures you would typically use to

862

00:33:53,570 --> 00:33:52,440

interpret the origin of the Rocks but by

863

00:33:55,430 --> 00:33:53,580

the time we got down to the look

864

00:33:57,049 --> 00:33:55,440

Education marked here at rubion which

865

00:33:59,029 --> 00:33:57,059

Jennifer talked about the first place we

866

00:34:01,310 --> 00:33:59,039

we took our sample we had the

867

00:34:03,769 --> 00:34:01,320

opportunity to actually scrape through

868

00:34:05,930 --> 00:34:03,779

the the natural surface of the rock to

869

00:34:08,089 --> 00:34:05,940

see what lied beneath and so if we bring

870

00:34:10,310 --> 00:34:08,099

up the next slide this is

871

00:34:12,470 --> 00:34:10,320

um yeah so this is our first abrasion

872

00:34:15,710 --> 00:34:12,480

and Jennifer mentioned that these rocks

873

00:34:17,930 --> 00:34:15,720

uh have interacted uh and have been

874

00:34:19,790 --> 00:34:17,940

altered and weathered and that's exactly

875

00:34:21,649 --> 00:34:19,800

what we saw here as well you can see

876

00:34:23,810 --> 00:34:21,659

those holes and those are holes in the

877

00:34:26,329 --> 00:34:23,820

Rock and not just caused by wind

878

00:34:28,369 --> 00:34:26,339

particle or sand particles blasting the

879

00:34:30,710 --> 00:34:28,379

rock these are actually inside the rock

880

00:34:32,690 --> 00:34:30,720

suggesting that water has moved through

881

00:34:35,030 --> 00:34:32,700

this rock and eaten away parts of that

882

00:34:37,190 --> 00:34:35,040

rock but when we looked at this texture

883

00:34:40,069 --> 00:34:37,200

this variation of light and dark

884

00:34:42,649 --> 00:34:40,079

minerals this is pretty Diagnostic and

885

00:34:44,990 --> 00:34:42,659

conclusive for an igneous rock and we

886

00:34:47,629 --> 00:34:45,000

think it was formed by volcanic lava

887

00:34:49,369 --> 00:34:47,639

flows and and so the but the other neat

888

00:34:50,869 --> 00:34:49,379

thing about this in the where we start

889

00:34:53,030 --> 00:34:50,879

to think about habitability and

890

00:34:54,710 --> 00:34:53,040

astrobiology potential is that some of

891

00:34:56,930 --> 00:34:54,720

those light colored minerals you see

892

00:34:59,690 --> 00:34:56,940

there those are salt minerals and those

893

00:35:01,849 --> 00:34:59,700

only form by precipitating out of water

894

00:35:03,650 --> 00:35:01,859

moving through these rocks so while we

895

00:35:05,690 --> 00:35:03,660

don't typically think of volcanic or

896

00:35:07,370 --> 00:35:05,700

igneous rocks as the prime place to look

897

00:35:09,890 --> 00:35:07,380

for signs of ancient life at least here

898

00:35:11,510 --> 00:35:09,900

on Earth given that water has moved

899

00:35:14,210 --> 00:35:11,520

through these rocks there might have

900

00:35:15,890 --> 00:35:14,220

been habitable niches in this rock that

901
00:35:18,650 --> 00:35:15,900
capable of supporting signs of ancient

902
00:35:21,349 --> 00:35:18,660
life and so that's pretty exciting to

903
00:35:24,650 --> 00:35:21,359
find igneous rocks here those are great

904
00:35:27,050 --> 00:35:24,660
rocks to to get age dates from and learn

905
00:35:28,849 --> 00:35:27,060
about processes in the interior of Mars

906
00:35:31,010 --> 00:35:28,859
as well as to have this potential

907
00:35:33,890 --> 00:35:31,020
habitability aspect of these rocks as

908
00:35:36,589 --> 00:35:33,900
well and so so really exciting to have

909
00:35:38,690 --> 00:35:36,599
this kind of Discovery and and to answer

910
00:35:40,250 --> 00:35:38,700
that question volcanic or sedimentary we

911
00:35:41,829 --> 00:35:40,260
answered that in the in the first year

912
00:35:44,150 --> 00:35:41,839
of the mission

913
00:35:47,329 --> 00:35:44,160

that's amazing to have those answers

914

00:35:48,829 --> 00:35:47,339

already so taking those answers

915

00:35:50,810 --> 00:35:48,839

because science is always about what's

916

00:35:52,490 --> 00:35:50,820

the next question what can this teach us

917

00:35:54,710 --> 00:35:52,500

where can we go from here

918

00:35:55,970 --> 00:35:54,720

yeah so from a science and sampling

919

00:35:58,069 --> 00:35:55,980

perspective and as a reminder

920

00:36:01,010 --> 00:35:58,079

perseverance is on the surface to

921

00:36:04,190 --> 00:36:01,020

collect uh samples uh for possible

922

00:36:07,010 --> 00:36:04,200

return to Earth jezero has been a slam

923

00:36:09,710 --> 00:36:07,020

dunk we have from the surface even

924

00:36:11,690 --> 00:36:09,720

though we landed on the igneous rocks we

925

00:36:13,370 --> 00:36:11,700

had views of the sedimentary rocks that

926

00:36:15,829 --> 00:36:13,380

we know are in the future of the

927

00:36:19,250 --> 00:36:15,839

Rover and that we're heading to soon but

928

00:36:22,069 --> 00:36:19,260

if we bring up uh slide 18 you'll see uh

929

00:36:23,810 --> 00:36:22,079

our current sample collection and so

930

00:36:26,870 --> 00:36:23,820

this is the collection of samples that

931

00:36:28,609 --> 00:36:26,880

are currently in inside the Rover uh

932

00:36:31,130 --> 00:36:28,619

getting ready in the future to

933

00:36:34,670 --> 00:36:31,140

potentially come back to earth and so we

934

00:36:36,530 --> 00:36:34,680

have a fantastic Suite of of rock

935

00:36:39,230 --> 00:36:36,540

samples that tell us again about the

936

00:36:42,230 --> 00:36:39,240

interior processes of a planet the the

937

00:36:43,910 --> 00:36:42,240

history of magma in the planet and

938

00:36:46,190 --> 00:36:43,920

perhaps erupting out on the surface as

939

00:36:47,810 --> 00:36:46,200

lava flows and then a history of the

940

00:36:49,790 --> 00:36:47,820

interaction of these rocks with water

941

00:36:51,890 --> 00:36:49,800

that might have created the potential

942

00:36:53,930 --> 00:36:51,900

for habitable environments as well as

943

00:36:55,910 --> 00:36:53,940

salt minerals that here on Earth we know

944

00:36:58,190 --> 00:36:55,920

are really good at preserving signs of

945

00:37:00,650 --> 00:36:58,200

ancient life here on Earth and the same

946

00:37:01,970 --> 00:37:00,660

could be true for Mars and so we've

947

00:37:03,410 --> 00:37:01,980

really hit it out of the park in this

948

00:37:05,450 --> 00:37:03,420

first year from a science perspective

949

00:37:07,250 --> 00:37:05,460

we've got sedimentary rocks we've got

950

00:37:09,710 --> 00:37:07,260

igneous rocks and jezers really come

951
00:37:13,970 --> 00:37:09,720
through on the diversity uh and the the

952
00:37:17,750 --> 00:37:16,310
wonderful so Nikki I know I've got more

953
00:37:19,010 --> 00:37:17,760
questions but what are they asking out

954
00:37:21,890 --> 00:37:19,020
there

955
00:37:25,010 --> 00:37:21,900
yeah so we've got a great question for

956
00:37:26,810 --> 00:37:25,020
Katie from Dan on Facebook specifically

957
00:37:28,730 --> 00:37:26,820
about what the core samples are telling

958
00:37:31,010 --> 00:37:28,740
us so have any of the drilled core

959
00:37:33,230 --> 00:37:31,020
samples produced any evidence of

960
00:37:35,270 --> 00:37:33,240
biological material or will we not know

961
00:37:37,550 --> 00:37:35,280
until they come back to earth

962
00:37:39,710 --> 00:37:37,560
yeah that's a great question and it's

963
00:37:43,010 --> 00:37:39,720

one that we think very carefully about

964

00:37:46,190 --> 00:37:43,020

the bar is really high for scientists on

965

00:37:47,750 --> 00:37:46,200

on Mars to make an assign to studying

966

00:37:49,790 --> 00:37:47,760

Mars to make an assessment of a

967

00:37:51,470 --> 00:37:49,800

potential bio signature

968

00:37:54,410 --> 00:37:51,480

um what I can say about some of these

969

00:37:56,810 --> 00:37:54,420

samples is that we have uh detected

970

00:37:58,430 --> 00:37:56,820

Organics like organic molecules and some

971

00:38:00,710 --> 00:37:58,440

of these samples and Organics are the

972

00:38:02,810 --> 00:38:00,720

building blocks of Life as We Know It

973

00:38:05,329 --> 00:38:02,820

And so there's nothing that we have yet

974

00:38:08,030 --> 00:38:05,339

determined to be conclusively biological

975

00:38:09,710 --> 00:38:08,040

in in the rocks that we've studied but

976

00:38:11,510 --> 00:38:09,720

fortunately with the potential for these

977

00:38:13,849 --> 00:38:11,520

rocks to come back to earth we can we

978

00:38:15,890 --> 00:38:13,859

can confirm that uh whether whether

979

00:38:18,050 --> 00:38:15,900

there are signs of ancient life here in

980

00:38:20,390 --> 00:38:18,060

these rocks so I think we are very much

981

00:38:23,150 --> 00:38:20,400

we very much collected a suite with the

982

00:38:25,430 --> 00:38:23,160

potential for that but we we haven't yet

983

00:38:28,250 --> 00:38:25,440

determined based on our data collected

984

00:38:29,630 --> 00:38:28,260

on the surface that any of these the

985

00:38:31,190 --> 00:38:29,640

things that we've found in these rocks

986

00:38:33,109 --> 00:38:31,200

or the Organics we found in these rocks

987

00:38:35,690 --> 00:38:33,119

could only have been formed by life

988

00:38:36,890 --> 00:38:35,700

we're not quite ready to say that um but

989

00:38:40,010 --> 00:38:36,900

fortunately we can answer that when

990

00:38:44,569 --> 00:38:42,109

there have been so many great questions

991

00:38:47,329 --> 00:38:44,579

so far so let's try to get as many as we

992

00:38:48,890 --> 00:38:47,339

possibly can let's bring Jennifer back

993

00:38:51,109 --> 00:38:48,900

in well I can have Katie and Jennifer

994

00:38:53,810 --> 00:38:51,119

both taking questions for for a little

995

00:38:56,630 --> 00:38:53,820

while uh we go what do we got Nikki

996

00:38:58,130 --> 00:38:56,640

yeah absolutely so uh for this question

997

00:39:00,349 --> 00:38:58,140

I'm going to ask Jennifer to start us

998

00:39:02,270 --> 00:39:00,359

off Joanne on Twitter wants to know what

999

00:39:04,690 --> 00:39:02,280

are your plans for the next year for

1000

00:39:10,790 --> 00:39:04,700

perseverance

1001

00:39:13,010 --> 00:39:10,800

months as I mentioned to be driving to

1002

00:39:16,130 --> 00:39:13,020

the Delta and so we're almost able to do

1003

00:39:18,230 --> 00:39:16,140

that and then we are going to spend a

1004

00:39:20,030 --> 00:39:18,240

year doing the Delta campaign in the

1005

00:39:22,190 --> 00:39:20,040

science Campaign which maybe Katie wants

1006

00:39:24,349 --> 00:39:22,200

to take that but the things we're doing

1007

00:39:25,910 --> 00:39:24,359

on the engineering side as well I said

1008

00:39:27,950 --> 00:39:25,920

we're upgrading and putting some more

1009

00:39:30,770 --> 00:39:27,960

autonomous capabilities on the Rover so

1010

00:39:34,190 --> 00:39:30,780

we're taking that first step of having

1011

00:39:36,589 --> 00:39:34,200

the Rover check its own energy and time

1012

00:39:38,990 --> 00:39:36,599

availability as a resource and if it has

1013

00:39:41,450 --> 00:39:39,000

more energy or more time at the end of a

1014

00:39:44,030 --> 00:39:41,460

saw which is a Martian day that we told

1015

00:39:46,069 --> 00:39:44,040

it to do it can actually pick from a set

1016

00:39:49,130 --> 00:39:46,079

of activities and keep going or it can

1017

00:39:50,810 --> 00:39:49,140

drive longer so we're getting ready to

1018

00:39:52,310 --> 00:39:50,820

to put some more of these autonomous

1019

00:39:54,650 --> 00:39:52,320

capabilities on which is very exciting

1020

00:39:56,630 --> 00:39:54,660

for me

1021

00:39:58,010 --> 00:39:56,640

that's great and Katie what about on the

1022

00:40:00,170 --> 00:39:58,020

science side what are we looking at for

1023

00:40:02,270 --> 00:40:00,180

the next year for perseverance

1024

00:40:05,510 --> 00:40:02,280

yeah so as Jennifer mentioned we are

1025

00:40:08,569 --> 00:40:05,520

just wrapping up our investigation of

1026

00:40:10,970 --> 00:40:08,579

the crater floor of Jezreel and we in

1027

00:40:13,130 --> 00:40:10,980

perhaps just another week or so we will

1028

00:40:15,470 --> 00:40:13,140

aim to collect another pair of samples

1029

00:40:17,569 --> 00:40:15,480

from what we think are these volcanic

1030

00:40:19,250 --> 00:40:17,579

rocks of the crater floor and then we

1031

00:40:20,930 --> 00:40:19,260

are hightailing it to the Delta as I

1032

00:40:23,329 --> 00:40:20,940

mentioned the Delta is our Prime

1033

00:40:25,309 --> 00:40:23,339

exploration Target within Jezreel and

1034

00:40:28,130 --> 00:40:25,319

perhaps the prime astrobiological target

1035

00:40:29,750 --> 00:40:28,140

within Jezreel and so at the delsa we

1036

00:40:31,309 --> 00:40:29,760

are really excited to transition from

1037

00:40:33,770 --> 00:40:31,319

the volcanic rocks we've been looking at

1038

00:40:36,109 --> 00:40:33,780

to this sedimentary rocks the sandstones

1039

00:40:38,569 --> 00:40:36,119

the mud Stones the conglomerates and one

1040

00:40:40,970 --> 00:40:38,579

of the neat things about a Delta is that

1041

00:40:43,089 --> 00:40:40,980

it has the it what it does is you have

1042

00:40:46,190 --> 00:40:43,099

rivers from outside the crater

1043

00:40:48,230 --> 00:40:46,200

collecting rocks and boulders from some

1044

00:40:50,390 --> 00:40:48,240

of the ancient most ancient old oldest

1045

00:40:52,069 --> 00:40:50,400

crust on Mars and bringing it to us

1046

00:40:54,950 --> 00:40:52,079

bringing it to the Rover so we don't

1047

00:40:56,870 --> 00:40:54,960

have to Rove for kilometers outside to

1048

00:40:59,270 --> 00:40:56,880

actually see the rocks of the crust of

1049

00:41:01,010 --> 00:40:59,280

Mars they come to us and that's again

1050

00:41:03,530 --> 00:41:01,020

the great thing about Adele this so

1051
00:41:05,510 --> 00:41:03,540
we're expecting to have the diversity of

1052
00:41:07,490 --> 00:41:05,520
the Martian Crest here in the Delta for

1053
00:41:09,829 --> 00:41:07,500
us to explore as well as those

1054
00:41:12,170 --> 00:41:09,839
fine-grained layered sedimentary rocks

1055
00:41:15,290 --> 00:41:12,180
that may be the key to finding ancient

1056
00:41:17,270 --> 00:41:15,300
biosignatures on Mars

1057
00:41:18,470 --> 00:41:17,280
that's awesome thank you for sharing

1058
00:41:20,089 --> 00:41:18,480
that it sounds like you've got a full

1059
00:41:22,329 --> 00:41:20,099
year ahead of you one full year done

1060
00:41:25,790 --> 00:41:22,339
another full year to celebrate in a year

1061
00:41:28,970 --> 00:41:25,800
we've had a ton of questions about the

1062
00:41:31,010 --> 00:41:28,980
geology of Mars so Katie I want to ask

1063
00:41:33,589 --> 00:41:31,020

you Robin on Facebook has asked how

1064

00:41:36,109 --> 00:41:33,599

geologically active is Mars today and

1065

00:41:38,750 --> 00:41:36,119

Benjamin also wants to know from

1066

00:41:40,970 --> 00:41:38,760

LinkedIn are there any minerals we found

1067

00:41:42,770 --> 00:41:40,980

unlike Earth

1068

00:41:46,250 --> 00:41:42,780

yeah those are two really great

1069

00:41:48,290 --> 00:41:46,260

questions and while I typically don't

1070

00:41:51,170 --> 00:41:48,300

think of Mars as being the most active

1071

00:41:53,450 --> 00:41:51,180

geological geologically today there are

1072

00:41:55,130 --> 00:41:53,460

actual processes happening right now

1073

00:41:56,809 --> 00:41:55,140

they're they're just not the ones that

1074

00:41:59,630 --> 00:41:56,819

we necessarily see preserved in the Rock

1075

00:42:01,670 --> 00:41:59,640

record so the wind blows on Mars we know

1076
00:42:04,010 --> 00:42:01,680
that impact craters are still forming on

1077
00:42:07,550 --> 00:42:04,020
Mars Mars has its a very active

1078
00:42:10,130 --> 00:42:07,560
atmospheric in processes occur and and

1079
00:42:12,650 --> 00:42:10,140
the environment is very Dynamic uh and

1080
00:42:14,630 --> 00:42:12,660
very different than our own Planet but

1081
00:42:16,970 --> 00:42:14,640
from the perspective of things like

1082
00:42:19,790 --> 00:42:16,980
water at the surface and and volcanism

1083
00:42:22,010 --> 00:42:19,800
you know that part of Mars history is in

1084
00:42:23,690 --> 00:42:22,020
the very distant past but there is a

1085
00:42:25,609 --> 00:42:23,700
modern environment that is still very

1086
00:42:27,530 --> 00:42:25,619
active and and we have instruments on

1087
00:42:29,450 --> 00:42:27,540
perseverance and scientists who are

1088
00:42:32,030 --> 00:42:29,460

studying the the present day active

1089

00:42:34,670 --> 00:42:32,040

environment of Mars in terms of the

1090

00:42:36,770 --> 00:42:34,680

minerals there have been other places on

1091

00:42:38,870 --> 00:42:36,780

on Mars where we have detected minerals

1092

00:42:41,809 --> 00:42:38,880

that are quite rare on Earth and and

1093

00:42:43,430 --> 00:42:41,819

very specialized places uh so far here

1094

00:42:45,530 --> 00:42:43,440

in jezro the minerals have been very

1095

00:42:47,630 --> 00:42:45,540

familiar and I mentioned the the

1096

00:42:49,670 --> 00:42:47,640

interesting dichotomy of a familiar but

1097

00:42:52,130 --> 00:42:49,680

alien world and and so far from a

1098

00:42:53,870 --> 00:42:52,140

mineral perspective Jezreel has been

1099

00:42:55,309 --> 00:42:53,880

very familiar we've had the same kind of

1100

00:42:58,370 --> 00:42:55,319

minerals in these rocks that we expect

1101
00:43:01,130 --> 00:42:58,380
in lava rocks on Earth basalt rocks we

1102
00:43:02,809 --> 00:43:01,140
have pyroxine plagi Clays and and we

1103
00:43:04,670 --> 00:43:02,819
have Olivine the interesting thing about

1104
00:43:07,309 --> 00:43:04,680
about Olivine we have rocks here in

1105
00:43:09,230 --> 00:43:07,319
Jezreel with a lot of Olivine and

1106
00:43:12,109 --> 00:43:09,240
Olivine is a mineral that crystallizes

1107
00:43:13,849 --> 00:43:12,119
directly out of a magma and it's pretty

1108
00:43:16,730 --> 00:43:13,859
rare to find rocks on Earth that are

1109
00:43:19,130 --> 00:43:16,740
really rich in Olivine but here on on

1110
00:43:21,890 --> 00:43:19,140
Mars and in jezra we have a geologic

1111
00:43:23,809 --> 00:43:21,900
unit that is primarily made of Olivine

1112
00:43:26,450 --> 00:43:23,819
so that's a really interesting kind of

1113
00:43:27,890 --> 00:43:26,460

rock unit but so far very familiar as

1114

00:43:32,030 --> 00:43:27,900

well as the salt minerals that we've

1115

00:43:33,710 --> 00:43:32,040

seen so far halite sulfate minerals

1116

00:43:36,470 --> 00:43:33,720

those are very common here on Earth and

1117

00:43:40,010 --> 00:43:36,480

so so far the minerals of Jezreel have

1118

00:43:44,089 --> 00:43:42,170

well that's good to know that there's a

1119

00:43:46,550 --> 00:43:44,099

whole mix of more on the familiar side

1120

00:43:48,470 --> 00:43:46,560

but a little bit of Rare Minerals if you

1121

00:43:51,589 --> 00:43:48,480

will from Earth I want to switch over

1122

00:43:53,870 --> 00:43:51,599

Jennifer and ask you a question from

1123

00:43:56,750 --> 00:43:53,880

gunjan on LinkedIn who wants to know

1124

00:43:59,270 --> 00:43:56,760

what is the one area requiring the most

1125

00:44:02,690 --> 00:43:59,280

amount of repair or troubleshooting on

1126
00:44:08,510 --> 00:44:05,510
yeah the Rover has been fortunately very

1127
00:44:10,130 --> 00:44:08,520
well behaved my previous Rovers I would

1128
00:44:11,349 --> 00:44:10,140
say took more troubleshooting so I'm

1129
00:44:14,930 --> 00:44:11,359
thankful for that

1130
00:44:17,750 --> 00:44:14,940
we have a very complex sampling system

1131
00:44:20,690 --> 00:44:17,760
and the sampling system even though it

1132
00:44:23,750 --> 00:44:20,700
has worked really well we've had the

1133
00:44:25,790 --> 00:44:23,760
challenges with the Pebbles being stuck

1134
00:44:27,530 --> 00:44:25,800
in different regions and having to

1135
00:44:31,190 --> 00:44:27,540
remove those as well as that first

1136
00:44:33,890 --> 00:44:31,200
sample not being collected we've also

1137
00:44:35,750 --> 00:44:33,900
had um and so those were those were the

1138
00:44:37,730 --> 00:44:35,760

biggest challenges took us the most time

1139

00:44:40,130 --> 00:44:37,740

to figure out where we spend some time

1140

00:44:41,750 --> 00:44:40,140

really thinking on Earth we had a couple

1141

00:44:45,109 --> 00:44:41,760

other challenges we have some Hardware

1142

00:44:47,150 --> 00:44:45,119

that sometimes will get bit errors and

1143

00:44:49,370 --> 00:44:47,160

that may just be the radiation

1144

00:44:52,130 --> 00:44:49,380

environment or you know sometimes solar

1145

00:44:54,770 --> 00:44:52,140

weather can affect us so but in general

1146

00:44:57,290 --> 00:44:54,780

those are the challenges really we've

1147

00:44:58,670 --> 00:44:57,300

had some issues with that those rocks in

1148

00:45:00,109 --> 00:44:58,680

our sampling hardware and that's about

1149

00:45:09,050 --> 00:45:00,119

it

1150

00:45:11,030 --> 00:45:09,060

I will add one um just I'll speak for

1151

00:45:13,010 --> 00:45:11,040

Ingenuity but we've kind of you know

1152

00:45:14,750 --> 00:45:13,020

brought Ingenuity in where the

1153

00:45:17,569 --> 00:45:14,760

communication relay station for

1154

00:45:19,130 --> 00:45:17,579

Ingenuity and uh in January when we were

1155

00:45:21,349 --> 00:45:19,140

going through this issue with the rock

1156

00:45:24,770 --> 00:45:21,359

the Pebbles and the bit Carousel we had

1157

00:45:27,170 --> 00:45:24,780

un uh kind of non-standard dust storms

1158

00:45:29,569 --> 00:45:27,180

and those dust storms were they put some

1159

00:45:32,930 --> 00:45:29,579

dust on our has cams and they put some

1160

00:45:34,730 --> 00:45:32,940

dust in ingenuities rotors in a way that

1161

00:45:37,609 --> 00:45:34,740

uh the next time we try to spin those

1162

00:45:40,130 --> 00:45:37,619

rotors we saw that they that we had

1163

00:45:41,630 --> 00:45:40,140

um more drag than we intended and so we

1164

00:45:43,190 --> 00:45:41,640

actually had to clean those out a little

1165

00:45:45,170 --> 00:45:43,200

bit so that we could keep flying

1166

00:45:47,030 --> 00:45:45,180

Ingenuity but they're clean now and we

1167

00:45:50,030 --> 00:45:47,040

just finished another flight so it's

1168

00:45:51,650 --> 00:45:50,040

it's looking good as well

1169

00:45:52,849 --> 00:45:51,660

well thanks for that update as well how

1170

00:45:54,890 --> 00:45:52,859

did you know they were asking about

1171

00:45:58,010 --> 00:45:54,900

Ingenuity in the chat as well so thanks

1172

00:46:00,650 --> 00:45:58,020

for the update on how everybody

1173

00:46:04,370 --> 00:46:02,809

uh so Katie I'm gonna throw this one to

1174

00:46:08,089 --> 00:46:04,380

you we've gotten quite a few questions

1175

00:46:09,589 --> 00:46:08,099

about the Mars sample return Mission

1176

00:46:11,630 --> 00:46:09,599

um but this one in particular is from

1177

00:46:14,210 --> 00:46:11,640

Jordan on LinkedIn who wants to know

1178

00:46:17,150 --> 00:46:14,220

what would the procedures be to prevent

1179

00:46:19,190 --> 00:46:17,160

contamination of off-planet samples once

1180

00:46:21,829 --> 00:46:19,200

they are brought back

1181

00:46:23,930 --> 00:46:21,839

that is a great question and we have a

1182

00:46:25,250 --> 00:46:23,940

whole branch of of NASA that thinks

1183

00:46:27,050 --> 00:46:25,260

about that that's called planetary

1184

00:46:29,329 --> 00:46:27,060

protection and it's something that we

1185

00:46:31,130 --> 00:46:29,339

take very seriously you know it and it

1186

00:46:32,809 --> 00:46:31,140

starts to cross into the realm sometimes

1187

00:46:35,630 --> 00:46:32,819

of Science Fiction but again it is

1188

00:46:37,430 --> 00:46:35,640

something to take seriously

1189

00:46:39,410 --> 00:46:37,440

um and and something we think about when

1190

00:46:42,290 --> 00:46:39,420

we bring samples from another world and

1191

00:46:44,809 --> 00:46:42,300

in a world that could possibly support

1192

00:46:45,710 --> 00:46:44,819

life and that we know or that we don't

1193

00:46:47,390 --> 00:46:45,720

know

1194

00:46:49,910 --> 00:46:47,400

um and so when we think about bringing

1195

00:46:51,710 --> 00:46:49,920

samples back to Earth we talk about bio

1196

00:46:53,569 --> 00:46:51,720

containment facilities and and having

1197

00:46:56,750 --> 00:46:53,579

the kind of facilities and Laboratories

1198

00:46:59,690 --> 00:46:56,760

here on Earth that we use to treat the

1199

00:47:01,430 --> 00:46:59,700

most sensitive uh biological things here

1200

00:47:02,990 --> 00:47:01,440

as well and so that's the kind of

1201
00:47:04,550 --> 00:47:03,000
facilities that we would develop and

1202
00:47:07,069 --> 00:47:04,560
that NASA is working with its

1203
00:47:09,829 --> 00:47:07,079
International Partners to develop to

1204
00:47:11,930 --> 00:47:09,839
support uh and house those samples when

1205
00:47:13,550 --> 00:47:11,940
we hope when we get them back so so

1206
00:47:15,230 --> 00:47:13,560
that's something that the NASA and its

1207
00:47:18,349 --> 00:47:15,240
partners are looking at and looking to

1208
00:47:19,970 --> 00:47:18,359
develop to make sure that that we stay

1209
00:47:22,069 --> 00:47:19,980
safe and that the same samples are safe

1210
00:47:24,109 --> 00:47:22,079
as well

1211
00:47:26,630 --> 00:47:24,119
thank goodness for planetary protection

1212
00:47:28,370 --> 00:47:26,640
I think we have time for only one more

1213
00:47:30,410 --> 00:47:28,380

question now I know there's been lots of

1214

00:47:31,730 --> 00:47:30,420

questions so thank you all so much who

1215

00:47:33,829 --> 00:47:31,740

have tuned in and asked your questions

1216

00:47:35,210 --> 00:47:33,839

in the chat tonight this one is for both

1217

00:47:38,390 --> 00:47:35,220

of you but I'm gonna have Jennifer start

1218

00:47:40,370 --> 00:47:38,400

us off summer on LinkedIn asks so many

1219

00:47:43,309 --> 00:47:40,380

cool things are going on what would you

1220

00:47:45,589 --> 00:47:43,319

tell a stem or creative student who

1221

00:47:47,510 --> 00:47:45,599

really wants to work at Nasa things they

1222

00:47:49,970 --> 00:47:47,520

should know also did you always want to

1223

00:47:51,950 --> 00:47:49,980

work at NASA

1224

00:47:54,410 --> 00:47:51,960

so I'll start with the second part

1225

00:47:57,910 --> 00:47:54,420

because I'm actually a farm girl from

1226

00:48:01,430 --> 00:47:57,920

Ohio and I spent my Summers as a

1227

00:48:03,349 --> 00:48:01,440

teenager in the field said sometimes we

1228

00:48:06,349 --> 00:48:03,359

were I was weeding the bean fields and I

1229

00:48:08,690 --> 00:48:06,359

was painting the barn roof and all these

1230

00:48:12,410 --> 00:48:08,700

great things and so I didn't necessarily

1231

00:48:14,750 --> 00:48:12,420

see myself as a NASA engineer however my

1232

00:48:17,210 --> 00:48:14,760

dad had worked in the missile industry

1233

00:48:19,309 --> 00:48:17,220

back in the Nike Zeus days and he had

1234

00:48:20,930 --> 00:48:19,319

some really cool stories and I just

1235

00:48:23,630 --> 00:48:20,940

thought oh that sounds adventurous so I

1236

00:48:26,150 --> 00:48:23,640

ended up going to MIT and and getting a

1237

00:48:28,910 --> 00:48:26,160

job at JPL which I just thought was the

1238

00:48:32,150 --> 00:48:28,920

coolest thing and so you know with that

1239

00:48:35,990 --> 00:48:32,160

background one thing I will say is if

1240

00:48:38,390 --> 00:48:36,000

you work hard and are passionate about

1241

00:48:40,490 --> 00:48:38,400

what you're working hard on and you just

1242

00:48:42,890 --> 00:48:40,500

you know you persevere through your

1243

00:48:44,510 --> 00:48:42,900

challenges and you have Ingenuity on the

1244

00:48:46,549 --> 00:48:44,520

things you're trying to solve you know

1245

00:48:49,490 --> 00:48:46,559

you could be a farm girl from Ohio who

1246

00:48:51,230 --> 00:48:49,500

didn't know what NASA was and you can be

1247

00:48:53,450 --> 00:48:51,240

the project manager of the perseverance

1248

00:48:55,849 --> 00:48:53,460

Rover so I you know there really are no

1249

00:48:59,630 --> 00:48:55,859

limits and then the other thing I would

1250

00:49:01,549 --> 00:48:59,640

say is um you know don't do is just try

1251

00:49:04,490 --> 00:49:01,559

different things there are lots of ways

1252

00:49:06,349 --> 00:49:04,500

you can be involved in the program and

1253

00:49:08,030 --> 00:49:06,359

working for NASA and these missions you

1254

00:49:10,190 --> 00:49:08,040

can you know get into the science like

1255

00:49:12,470 --> 00:49:10,200

Katie you can do the engineering and

1256

00:49:14,750 --> 00:49:12,480

autonomy like me you can do the media

1257

00:49:16,370 --> 00:49:14,760

and Outreach right like Brian and the

1258

00:49:18,770 --> 00:49:16,380

other folks here there's so many videos

1259

00:49:21,530 --> 00:49:18,780

and and taking all these images and

1260

00:49:22,849 --> 00:49:21,540

doing Productions and and even we have

1261

00:49:25,730 --> 00:49:22,859

this great partnership with Hollywood

1262

00:49:27,950 --> 00:49:25,740

where you know they help take our

1263

00:49:30,170 --> 00:49:27,960

messages a little bit more clearly to

1264

00:49:31,370 --> 00:49:30,180

the public than sometimes we can do and

1265

00:49:33,530 --> 00:49:31,380

so

1266

00:49:35,569 --> 00:49:33,540

um you know I don't know what part of it

1267

00:49:38,270 --> 00:49:35,579

you'd like to do but there are so many

1268

00:49:41,809 --> 00:49:38,280

options and opportunities for you to be

1269

00:49:44,630 --> 00:49:41,819

a part of exploration

1270

00:49:46,010 --> 00:49:44,640

that is some great advice Jennifer and I

1271

00:49:47,870 --> 00:49:46,020

want to give Katie a chance to answer

1272

00:49:49,190 --> 00:49:47,880

that too especially because before we

1273

00:49:50,870 --> 00:49:49,200

came on this call Katie was talking

1274

00:49:52,849 --> 00:49:50,880

about how much fun she has working as

1275

00:49:54,049 --> 00:49:52,859

part of the perseverance team so Katie

1276

00:49:55,370 --> 00:49:54,059

what advice do you have for students and

1277

00:49:56,510 --> 00:49:55,380

did you always know you wanted to do

1278

00:49:59,210 --> 00:49:56,520

this

1279

00:50:00,829 --> 00:49:59,220

yeah so I I've always been interested

1280

00:50:03,829 --> 00:50:00,839

in and even going back when I was a kid

1281

00:50:05,750 --> 00:50:03,839

I was always fascinated by things beyond

1282

00:50:07,849 --> 00:50:05,760

our own planet and for a long time I

1283

00:50:09,710 --> 00:50:07,859

thought it was stars and black holes and

1284

00:50:13,130 --> 00:50:09,720

galaxies and astronomy was really where

1285

00:50:15,049 --> 00:50:13,140

my focus was and I would always look

1286

00:50:17,569 --> 00:50:15,059

forward to going to museums on school

1287

00:50:19,069 --> 00:50:17,579

field trips and seeing planetarium shows

1288

00:50:21,770 --> 00:50:19,079

and that type of thing so I've always

1289

00:50:24,410 --> 00:50:21,780

had an interest in that but it it didn't

1290

00:50:26,630 --> 00:50:24,420

really crisp up uh in in working for

1291

00:50:28,370 --> 00:50:26,640

NASA until much later and I think it was

1292

00:50:30,650 --> 00:50:28,380

a series of decisions I made like

1293

00:50:32,569 --> 00:50:30,660

Jennifer suggested suggested trying new

1294

00:50:34,910 --> 00:50:32,579

things and following your passion kind

1295

00:50:36,829 --> 00:50:34,920

of led me here and and I even in

1296

00:50:40,010 --> 00:50:36,839

graduate school I I didn't know I wanted

1297

00:50:41,630 --> 00:50:40,020

to do this kind of work and I I was

1298

00:50:43,490 --> 00:50:41,640

lucky and the timing was good I found

1299

00:50:46,190 --> 00:50:43,500

myself on the Curiosity Rover that

1300

00:50:48,650 --> 00:50:46,200

Jennifer also helped to lead and I

1301
00:50:50,089 --> 00:50:48,660
realized wow I love this work working at

1302
00:50:52,250 --> 00:50:50,099
the intersection of science and

1303
00:50:54,890 --> 00:50:52,260
engineering and having new problems to

1304
00:50:57,230 --> 00:50:54,900
solve every day uh was just so exciting

1305
00:50:59,210 --> 00:50:57,240
to me and so I I kind of fell into this

1306
00:51:01,490 --> 00:50:59,220
through a series of decisions and and

1307
00:51:04,010 --> 00:51:01,500
following my my interests in terms of

1308
00:51:05,809 --> 00:51:04,020
advice that I would give especially as a

1309
00:51:08,569 --> 00:51:05,819
scientist I think the most important

1310
00:51:10,309 --> 00:51:08,579
thing is to ask questions and and by

1311
00:51:12,710 --> 00:51:10,319
asking questions about

1312
00:51:14,630 --> 00:51:12,720
your everyday life your surroundings the

1313
00:51:16,370 --> 00:51:14,640

things people say that's how you can be

1314

00:51:18,109 --> 00:51:16,380

an everyday scientist because that's

1315

00:51:20,150 --> 00:51:18,119

really what being a scientist is all

1316

00:51:21,589 --> 00:51:20,160

about is asking questions and then

1317

00:51:24,710 --> 00:51:21,599

trying to seek the answers to those

1318

00:51:27,470 --> 00:51:24,720

questions and and anybody can do it any

1319

00:51:29,569 --> 00:51:27,480

age any place on any topic we can be

1320

00:51:31,490 --> 00:51:29,579

everyday scientists and so that's what I

1321

00:51:32,870 --> 00:51:31,500

encourage folks to just ask as many

1322

00:51:35,510 --> 00:51:32,880

questions as you can and there's no such

1323

00:51:37,309 --> 00:51:35,520

thing as a bad question so don't be shy

1324

00:51:38,569 --> 00:51:37,319

about it and just go for it if you if

1325

00:51:41,270 --> 00:51:38,579

you don't get something there's a good

1326

00:51:42,770 --> 00:51:41,280

chance someone else doesn't either so uh

1327

00:51:46,250 --> 00:51:42,780

just go out there and ask ask questions

1328

00:51:48,650 --> 00:51:46,260

and question what what is around you

1329

00:51:49,309 --> 00:51:48,660

that's such great advice

1330

00:51:50,809 --> 00:51:49,319

um

1331

00:51:53,089 --> 00:51:50,819

that's all the time we have for tonight

1332

00:51:55,010 --> 00:51:53,099

I want to remind you all to join us next

1333

00:51:56,870 --> 00:51:55,020

month for when we talk about it's uh

1334

00:51:59,630 --> 00:51:56,880

called Moondance dynamics of the moons

1335

00:52:01,130 --> 00:51:59,640

of the outer solar system but before we

1336

00:52:02,690 --> 00:52:01,140

say goodbye I'd like to thank our

1337

00:52:04,910 --> 00:52:02,700

speakers Jennifer Trospen and Katie

1338

00:52:07,190 --> 00:52:04,920

stack Morgan for taking the time today

1339

00:52:09,410 --> 00:52:07,200

to share their passion and their

1340

00:52:10,790 --> 00:52:09,420

expertise with us this evening I just

1341

00:52:12,290 --> 00:52:10,800

want to thank Nikki and everyone behind

1342

00:52:14,870 --> 00:52:12,300

the scenes who make these talks possible

1343

00:52:17,329 --> 00:52:14,880

and finally a big thank you to all of

1344

00:52:19,490 --> 00:52:17,339

you who join us every month

1345

00:52:22,609 --> 00:52:19,500

we can't do this without you so stay

1346

00:52:25,250 --> 00:52:22,619

safe stay kind stay curious and we'll