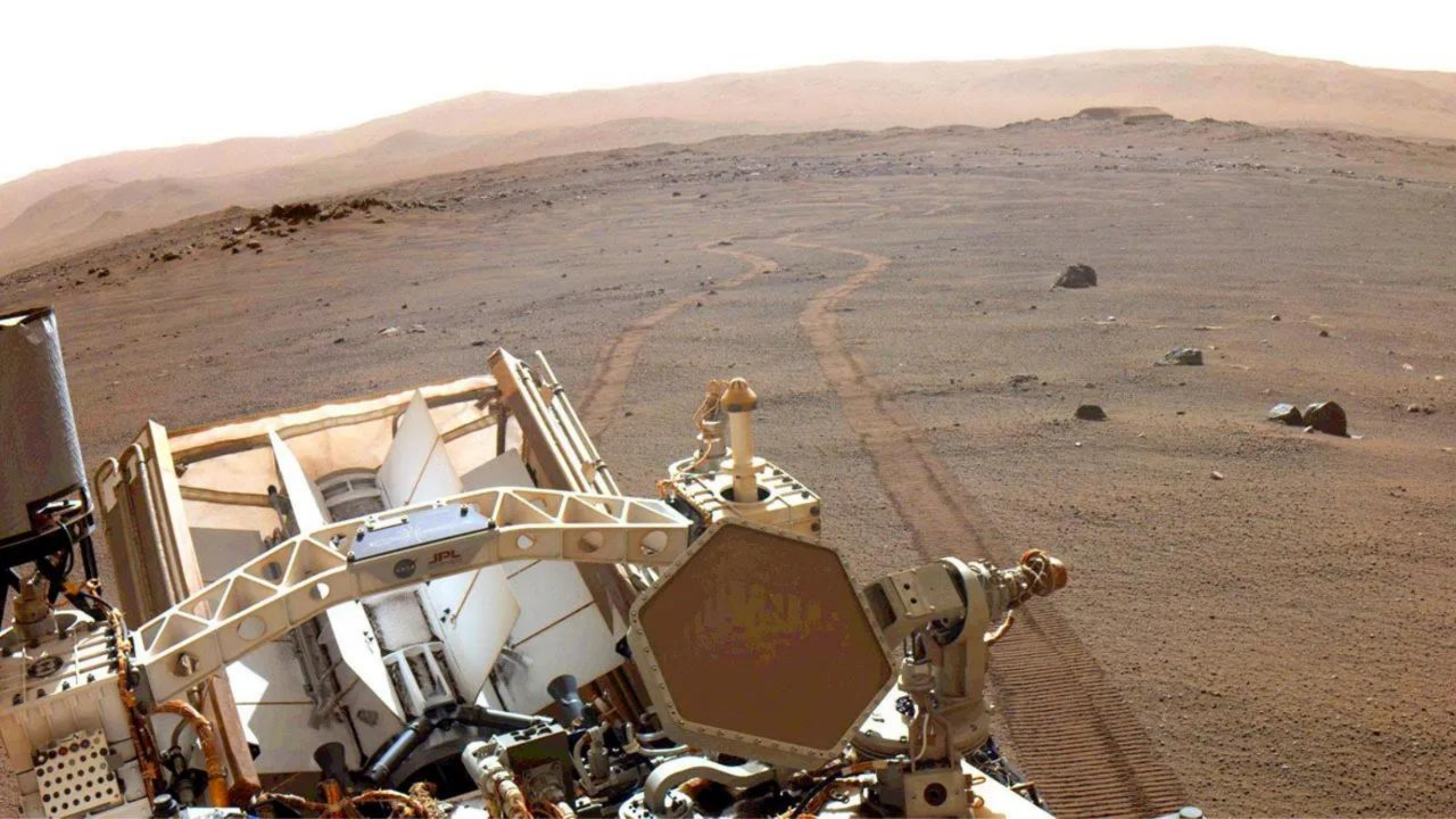
JPL

1
00:00:00,000 --> 00:00:08,270
solar system and all that lies Beyond

2
00:00:14,270 --> 00:00:10,910
hello and welcome to another edition of

3
00:00:16,369 --> 00:00:14,280
the 2023 Von Carmen lecture series I'm

4
00:00:18,590 --> 00:00:16,379
Nikki Wyrick with jpl's office of

5
00:00:20,570 --> 00:00:18,600
communications and education and I will

6
00:00:24,290 --> 00:00:20,580
be your host for our exciting topic this

7
00:00:27,529 --> 00:00:24,300
evening perseverance two years on Mars

8
00:00:30,290 --> 00:00:27,539
on February 18 2021 the perseverance

9
00:00:31,970 --> 00:00:30,300
Rover touched down at Jezreel crater a

10
00:00:34,310 --> 00:00:31,980
region of Mars where the ancient

11
00:00:37,069 --> 00:00:34,320
environment may have been favorable for

12
00:00:39,430 --> 00:00:37,079
microbial life mounted on the Rover's

13
00:00:42,170 --> 00:00:39,440

robotic arm Sherlock uses cameras

14
00:00:44,810 --> 00:00:42,180
spectrometers and a laser to search for

15
00:00:47,510 --> 00:00:44,820
Organics and minerals that have been

16
00:00:50,150 --> 00:00:47,520
altered by watery environments and may

17
00:00:52,850 --> 00:00:50,160
be signs of past microbial life

18
00:00:55,130 --> 00:00:52,860
joining us this evening as co-host is

19
00:00:57,650 --> 00:00:55,140
Sarah Marcotte Sarah brings over two

20
00:00:59,930 --> 00:00:57,660
decades of experience inspiring learning

21
00:01:02,209 --> 00:00:59,940
in out-of-school environments currently

22
00:01:05,090 --> 00:01:02,219
a public engagement specialist with Mars

23
00:01:07,609 --> 00:01:05,100
for JPL she works to connect Learners of

24
00:01:10,850 --> 00:01:07,619
all ages to current scientific research

25
00:01:13,969 --> 00:01:10,860
in person and online through events

26
00:01:17,750 --> 00:01:13,979
exhibits and virtual experiences hiya

27
00:01:20,210 --> 00:01:17,760
Sarah hello how are you Nikki I am well

28
00:01:23,149 --> 00:01:20,220
how are you this evening I'm doing well

29
00:01:25,609 --> 00:01:23,159
so tonight I will be taking your

30
00:01:28,370 --> 00:01:25,619
questions in the chat so if you are

31
00:01:31,070 --> 00:01:28,380
watching this webinar on LinkedIn

32
00:01:33,109 --> 00:01:31,080
Facebook live or YouTube make sure you

33
00:01:35,510 --> 00:01:33,119
put your questions in and our social

34
00:01:37,910 --> 00:01:35,520
media team will be sending those over to

35
00:01:40,789 --> 00:01:37,920
me and maybe your question will get

36
00:01:43,310 --> 00:01:40,799
asked and answered on air now if you

37
00:01:46,969 --> 00:01:43,320
don't see a chat box try refreshing your

38
00:01:49,190 --> 00:01:46,979

page or reloading your page and a place

39
00:01:50,149 --> 00:01:49,200
for for you to type in questions should

40
00:01:51,889 --> 00:01:50,159
appear

41
00:01:53,090 --> 00:01:51,899
and Nikki can I tell people about

42
00:01:56,210 --> 00:01:53,100
something really cool for this

43
00:01:59,450 --> 00:01:56,220
anniversary absolutely please do cool

44
00:02:02,090 --> 00:01:59,460
okay so um we have collected some of our

45
00:02:05,330 --> 00:02:02,100
favorite things from our website

46
00:02:08,210 --> 00:02:05,340
um into one place on our webpage so on

47
00:02:09,550 --> 00:02:08,220
the home page of the Mars program site

48
00:02:13,790 --> 00:02:09,560
it's

49
00:02:15,890 --> 00:02:13,800
mars.nasa.gov Mars 2020. we've collected

50
00:02:18,589 --> 00:02:15,900
some of our favorite experiences

51
00:02:19,790 --> 00:02:18,599
um to celebrate this anniversary so on

52
00:02:21,650 --> 00:02:19,800
this page

53
00:02:24,170 --> 00:02:21,660
um there's a whole bunch of links to

54
00:02:26,990 --> 00:02:24,180
other cool things on our site that use

55
00:02:29,750 --> 00:02:27,000
real data and in some cases some of the

56
00:02:32,750 --> 00:02:29,760
real tools that the mission teams use

57
00:02:35,330 --> 00:02:32,760
now for example we have a Mars photo

58
00:02:38,330 --> 00:02:35,340
booth and you can get real pictures of

59
00:02:41,690 --> 00:02:38,340
Mars and add yourself or your best

60
00:02:44,210 --> 00:02:41,700
friend to an image of mars or you can

61
00:02:48,110 --> 00:02:44,220
hear actual sounds recorded by the

62
00:02:49,729 --> 00:02:48,120
perseverance Rover first time ever in

63
00:02:51,830 --> 00:02:49,739

all the years we've been exploring Mars

64
00:02:53,930 --> 00:02:51,840
we've never captured captured actual

65
00:02:56,630 --> 00:02:53,940
sounds so you can hear those on that

66
00:02:58,490 --> 00:02:56,640
page and you can see a location map of

67
00:03:01,309 --> 00:02:58,500
exactly where perseverance and the

68
00:03:03,410 --> 00:03:01,319
Ingenuity helicopter are so all these

69
00:03:05,750 --> 00:03:03,420
neat experiences wrapped up in this one

70
00:03:07,910 --> 00:03:05,760
page is called the best of perseverance

71
00:03:09,710 --> 00:03:07,920
page and that's how I'm celebrating the

72
00:03:12,110 --> 00:03:09,720
anniversary this year

73
00:03:14,990 --> 00:03:12,120
awesome thank you for sharing that with

74
00:03:16,970 --> 00:03:15,000
our viewers tonight Sarah so I just want

75
00:03:18,710 --> 00:03:16,980
to remind all of you out there as always

76
00:03:20,449 --> 00:03:18,720
if we do run into any technical

77
00:03:22,309 --> 00:03:20,459
difficulties or small failures tonight

78
00:03:24,050 --> 00:03:22,319
we ask for your patience and please

79
00:03:25,850 --> 00:03:24,060
stick with us we will get them out as

80
00:03:28,009 --> 00:03:25,860
soon as we possibly can

81
00:03:31,130 --> 00:03:28,019
now a special treat for us our speaker

82
00:03:33,350 --> 00:03:31,140
this evening is Dr sananda Sharma an

83
00:03:35,690 --> 00:03:33,360
interdisciplinary scientist focusing on

84
00:03:37,729 --> 00:03:35,700
astrobiology research and currently

85
00:03:39,949 --> 00:03:37,739
supporting the Sherlock instrument on

86
00:03:42,410 --> 00:03:39,959
perseverance she aims to understand the

87
00:03:45,130 --> 00:03:42,420
limits of life and the detection of Bio

88
00:03:47,390 --> 00:03:45,140

signatures in extreme and Martian

89
00:03:49,670 --> 00:03:47,400
environments and she is particularly

90
00:03:51,910 --> 00:03:49,680
interested in spectroscopy and

91
00:03:55,250 --> 00:03:51,920
microscopy pigments as possible

92
00:03:57,649 --> 00:03:55,260
biosignatures and simulation of extreme

93
00:04:00,170 --> 00:03:57,659
environments but she is also passionate

94
00:04:01,970 --> 00:04:00,180
about cross-disciplinary research to

95
00:04:03,830 --> 00:04:01,980
promote greater inclusion and

96
00:04:07,070 --> 00:04:03,840
understanding across fields and

97
00:04:08,809 --> 00:04:07,080
audiences hi sananda

98
00:04:11,869 --> 00:04:08,819
hey there thanks so much for having me

99
00:04:13,429 --> 00:04:11,879
hey Sarah hey Nikki of course thank you

100
00:04:15,710 --> 00:04:13,439
so much for joining us for the special

101
00:04:17,150 --> 00:04:15,720
celebration this evening uh first off

102
00:04:19,430 --> 00:04:17,160
can you tell us just a little bit about

103
00:04:20,990 --> 00:04:19,440
who you are and how you got to work on

104
00:04:23,749 --> 00:04:21,000
this project

105
00:04:25,370 --> 00:04:23,759
yeah for sure so I am as you mentioned a

106
00:04:26,990 --> 00:04:25,380
postdoctoral fellow here at jet

107
00:04:30,050 --> 00:04:27,000
propulsion laboratory and I'm a member

108
00:04:32,629 --> 00:04:30,060
of the Mars 2020 uh Mission science team

109
00:04:34,490 --> 00:04:32,639
and my background is a little bit varied

110
00:04:36,650 --> 00:04:34,500
I've done a lot of microbiology

111
00:04:38,930 --> 00:04:36,660
neurobiology and design and architecture

112
00:04:40,850 --> 00:04:38,940
and now I focus on astrobiology and

113
00:04:43,610 --> 00:04:40,860

that's the study of the origins

114
00:04:46,490 --> 00:04:43,620
Evolution distribution and possible

115
00:04:49,430 --> 00:04:46,500
future of life in the universe

116
00:04:52,969 --> 00:04:49,440
and go ahead

117
00:04:54,530 --> 00:04:52,979
yeah so I was going to say so when I um

118
00:04:56,749 --> 00:04:54,540
so as I said my background's quite

119
00:04:58,969 --> 00:04:56,759
diverse and I applied for this postdoc

120
00:05:01,010 --> 00:04:58,979
position to join Sherlock when I just

121
00:05:02,810 --> 00:05:01,020
saw it posted online so the way that I

122
00:05:04,370 --> 00:05:02,820
got involved in it is

123
00:05:05,570 --> 00:05:04,380
um I had read a lot about Sherlock

124
00:05:07,249 --> 00:05:05,580
because it seemed like a very

125
00:05:10,370 --> 00:05:07,259
interesting instrument that combines all

126
00:05:12,110 --> 00:05:10,380
these unique capabilities and it gathers

127
00:05:13,670 --> 00:05:12,120
all this different type of data that

128
00:05:17,870 --> 00:05:13,680
gives a wealth of information about rock

129
00:05:19,670 --> 00:05:17,880
services so I had never been to JPL or

130
00:05:22,010 --> 00:05:19,680
done an internship here and a lot of

131
00:05:23,749 --> 00:05:22,020
folks who are postdocs have

132
00:05:25,249 --> 00:05:23,759
um but I didn't have the grades for it

133
00:05:26,810 --> 00:05:25,259
when I was an undergrad and it took me a

134
00:05:29,629 --> 00:05:26,820
long time to figure out how I actually

135
00:05:30,950 --> 00:05:29,639
learn and I learned by doing and I've

136
00:05:33,050 --> 00:05:30,960
always been really Hands-On with both

137
00:05:34,670 --> 00:05:33,060
research about science and art and

138
00:05:36,950 --> 00:05:34,680

that's a big part of my job now so I get

139
00:05:39,529 --> 00:05:36,960
to do a lot of Hands-On work in lab and

140
00:05:41,629 --> 00:05:39,539
also with Mission data as it comes down

141
00:05:43,550 --> 00:05:41,639
it's great that you found a place where

142
00:05:45,409 --> 00:05:43,560
you can integrate your passions and your

143
00:05:47,450 --> 00:05:45,419
love with your your work and your study

144
00:05:49,249 --> 00:05:47,460
so I'm glad you're here but can you tell

145
00:05:52,249 --> 00:05:49,259
us what has it been like these past two

146
00:05:55,730 --> 00:05:52,259
years working on perseverance

147
00:05:58,610 --> 00:05:55,740
yeah so in a word it's just thrilling so

148
00:06:01,129 --> 00:05:58,620
we're exploring different regions of

149
00:06:04,189 --> 00:06:01,139
um uh of Jezreel crater which is one

150
00:06:06,830 --> 00:06:04,199
part of Mars and that's a crater that's

151
00:06:08,629 --> 00:06:06,840
28 miles wide and it's a little north of

152
00:06:11,150 --> 00:06:08,639
the Martian equator

153
00:06:13,310 --> 00:06:11,160
and so there's evidence that this region

154
00:06:14,810 --> 00:06:13,320
was home to an ancient river Delta and

155
00:06:16,730 --> 00:06:14,820
there are a lot of minerals that were

156
00:06:18,529 --> 00:06:16,740
mapped both from orbit and things that

157
00:06:20,390 --> 00:06:18,539
we've seen from the Rover to date that

158
00:06:22,730 --> 00:06:20,400
indicate that there was water there in

159
00:06:25,730 --> 00:06:22,740
the past and it's possible that over 3.5

160
00:06:28,189 --> 00:06:25,740
billion years ago a lake existed here

161
00:06:30,529 --> 00:06:28,199
and I think so at this point now we've

162
00:06:32,990 --> 00:06:30,539
completed our journey through the crater

163
00:06:36,710 --> 00:06:33,000

floor and the Delta front and now we're

164
00:06:40,430 --> 00:06:36,720
starting on the Delta top so

165
00:06:44,689 --> 00:06:42,770
yeah so this shows in this image the

166
00:06:46,850 --> 00:06:44,699
white part shows the Traverse or where

167
00:06:48,350 --> 00:06:46,860
exactly the Rover has gone so far and so

168
00:06:50,029 --> 00:06:48,360
you can see we started in that crater

169
00:06:51,710 --> 00:06:50,039
floor area and that has some of the

170
00:06:53,210 --> 00:06:51,720
oldest rocks that we would encounter and

171
00:06:54,710 --> 00:06:53,220
it's rocks that we think were in place

172
00:06:57,950 --> 00:06:54,720
so they we don't think they were

173
00:06:59,629 --> 00:06:57,960
transported very much and as we move

174
00:07:01,610 --> 00:06:59,639
through into the Delta front area we

175
00:07:03,890 --> 00:07:01,620
spent a good amount of time there and we

176
00:07:05,390 --> 00:07:03,900
as um the instrument that I work on

177
00:07:07,730 --> 00:07:05,400
Sherlock we looked at 11 different

178
00:07:09,650 --> 00:07:07,740
targets that were there and now we're

179
00:07:10,909 --> 00:07:09,660
just starting the Delta top campaign and

180
00:07:12,170 --> 00:07:10,919
I'm very excited about this one because

181
00:07:13,969 --> 00:07:12,180
we're going to see some things that

182
00:07:17,990 --> 00:07:13,979
possibly we haven't seen before to date

183
00:07:21,950 --> 00:07:20,390
very cool so we've gotten an idea a

184
00:07:24,050 --> 00:07:21,960
little bit about what it's been like

185
00:07:26,689 --> 00:07:24,060
working on perseverance the last couple

186
00:07:29,870 --> 00:07:26,699
of years but can you tell us what is

187
00:07:31,309 --> 00:07:29,880
Sherlock the instrument that you work on

188
00:07:39,890 --> 00:07:31,319

yeah so

189
00:07:41,089 --> 00:07:39,900
acronym like many things that are here

190
00:07:42,529 --> 00:07:41,099
at JPL

191
00:07:44,390 --> 00:07:42,539
um it stands for scanning habitable

192
00:07:46,370 --> 00:07:44,400
environments with Raman and luminescence

193
00:07:47,689 --> 00:07:46,380
for Organics and chemicals and it's one

194
00:07:49,430 --> 00:07:47,699
of the seven scientific instruments

195
00:07:50,689 --> 00:07:49,440
that's on the perseverance Rover and

196
00:07:52,309 --> 00:07:50,699
it's on the Rover arm so you can see

197
00:07:54,529 --> 00:07:52,319
it's on that right side all circled

198
00:07:56,629 --> 00:07:54,539
there and that arm does a lot of work so

199
00:07:59,029 --> 00:07:56,639
it does our proximity science meaning it

200
00:08:00,230 --> 00:07:59,039
observes rocks really up close where

201
00:08:02,029 --> 00:08:00,240
some of the instruments are remote

202
00:08:03,230 --> 00:08:02,039
science instruments and they work from a

203
00:08:06,589 --> 00:08:03,240
little bit further away from a rock

204
00:08:08,330 --> 00:08:06,599
surface so Sherlock is a deep UV Ramen

205
00:08:10,129 --> 00:08:08,340
and fluorescent spectrometer with two

206
00:08:11,809 --> 00:08:10,139
different Imaging systems and one of

207
00:08:12,950 --> 00:08:11,819
them is called Watson so Sherlock and

208
00:08:14,870 --> 00:08:12,960
Watson

209
00:08:16,490 --> 00:08:14,880
um so when I said that it observes Rock

210
00:08:18,469 --> 00:08:16,500
surfaces up close I mean literally

211
00:08:20,749 --> 00:08:18,479
imagine the height of a credit card

212
00:08:23,210 --> 00:08:20,759
that's how far we are from Rock surfaces

213
00:08:24,710 --> 00:08:23,220

so 48 millimeters away and Sherlock

214
00:08:26,390 --> 00:08:24,720
gives multiple different types of

215
00:08:29,570 --> 00:08:26,400
information so it gives image

216
00:08:31,189 --> 00:08:29,580
information and Spectra and Spectra are

217
00:08:33,409 --> 00:08:31,199
basically signals that result from light

218
00:08:34,969 --> 00:08:33,419
interaction with a rock surface and the

219
00:08:37,130 --> 00:08:34,979
light that we use as a special type of

220
00:08:38,990 --> 00:08:37,140
laser that you can think of as sort of a

221
00:08:40,430 --> 00:08:39,000
fancy black light and it helps to see

222
00:08:42,529 --> 00:08:40,440
things that are in the rock that would

223
00:08:44,329 --> 00:08:42,539
be otherwise invisible to us so the

224
00:08:45,290 --> 00:08:44,339
images that we take with Sherlock's two

225
00:08:47,389 --> 00:08:45,300
cameras

226
00:08:48,650 --> 00:08:47,399
that provides visual context for where

227
00:08:51,769 --> 00:08:48,660
the laser hit

228
00:08:53,570 --> 00:08:51,779
so when Sherlock studies a rock surface

229
00:08:55,130 --> 00:08:53,580
it shoots its laser in a pattern across

230
00:08:57,410 --> 00:08:55,140
an area that's about the size of a

231
00:08:58,910 --> 00:08:57,420
pencil eraser so quite small and it

232
00:09:01,130 --> 00:08:58,920
lights up different components in the

233
00:09:03,530 --> 00:09:01,140
Rock including chemicals minerals and

234
00:09:05,750 --> 00:09:03,540
organic matter and organic matter or

235
00:09:08,090 --> 00:09:05,760
Organics as people sometimes say that is

236
00:09:10,009 --> 00:09:08,100
made up of the element carbon that's

237
00:09:13,250 --> 00:09:10,019
along with other elements like hydrogen

238
00:09:14,990 --> 00:09:13,260

nitrogen and oxygen and Organics are

239
00:09:16,730 --> 00:09:15,000
super interesting to us because they're

240
00:09:19,550 --> 00:09:16,740
commonly called the building blocks of

241
00:09:22,430 --> 00:09:19,560
life so all Life as we know it is made

242
00:09:24,050 --> 00:09:22,440
up of Organics but Organics importantly

243
00:09:26,449 --> 00:09:24,060
can also be made through other chemical

244
00:09:28,009 --> 00:09:26,459
processes such as through water Rock

245
00:09:30,290 --> 00:09:28,019
interactions and it's also found in

246
00:09:32,710 --> 00:09:30,300
Interstellar dust so what this two types

247
00:09:35,750 --> 00:09:32,720
of spectroscopy Sherlock helps the Rover

248
00:09:37,850 --> 00:09:35,760
detect different spatial patterns of

249
00:09:40,490 --> 00:09:37,860
Organics and minerals and give important

250
00:09:42,829 --> 00:09:40,500
views of samples that we're seeing with

251
00:09:44,389 --> 00:09:42,839
minimal alterations so we go up to a

252
00:09:46,970 --> 00:09:44,399
rock the only things that we would do is

253
00:09:49,070 --> 00:09:46,980
either blow dust off the surface or a

254
00:09:51,230 --> 00:09:49,080
braid meaning remove the top layer with

255
00:09:53,150 --> 00:09:51,240
a particular drill bit that we have and

256
00:09:57,769 --> 00:09:53,160
then just of the Rock in place so no

257
00:10:01,730 --> 00:09:59,329
so that's a great description of

258
00:10:05,509 --> 00:10:01,740
Sherlock but why would we want to have

259
00:10:08,690 --> 00:10:05,519
something like Sherlock on the Rover

260
00:10:13,490 --> 00:10:08,700
yeah so um let's put into context so if

261
00:10:17,030 --> 00:10:16,130
actually the one after this I think

262
00:10:19,430 --> 00:10:17,040
or

263
00:10:20,269 --> 00:10:19,440

yeah this one exactly perfect

264
00:10:21,889 --> 00:10:20,279
um so

265
00:10:23,449 --> 00:10:21,899
all of the instruments that we have

266
00:10:25,490 --> 00:10:23,459
worked together on the Rover quite

267
00:10:28,009 --> 00:10:25,500
elegantly and across all of them we can

268
00:10:31,130 --> 00:10:28,019
get chemical mineralogical Elemental

269
00:10:32,690 --> 00:10:31,140
textural color and stratigraphic data to

270
00:10:34,730 --> 00:10:32,700
catalog all the most detailed

271
00:10:36,769 --> 00:10:34,740
information possible across spatial

272
00:10:38,750 --> 00:10:36,779
scales and across observational axes so

273
00:10:40,850 --> 00:10:38,760
Sherlock as you can see is on like the

274
00:10:42,949 --> 00:10:40,860
finer scale so on the right side of the

275
00:10:44,690 --> 00:10:42,959
slide that's here so we work on the

276
00:10:46,610 --> 00:10:44,700
centimeter all the way down past the

277
00:10:48,769 --> 00:10:46,620
millimeter scale so we have some of the

278
00:10:50,990 --> 00:10:48,779
closest views that we've had to date of

279
00:10:52,550 --> 00:10:51,000
rocks on the Martian surface and

280
00:10:54,470 --> 00:10:52,560
Sherlock is the first of its kind

281
00:10:56,269 --> 00:10:54,480
instrument that's operating on Mars and

282
00:10:58,250 --> 00:10:56,279
it gives us especially important

283
00:10:59,810 --> 00:10:58,260
information about rocks that are as

284
00:11:02,569 --> 00:10:59,820
they're found to support the selection

285
00:11:04,910 --> 00:11:02,579
of samples for return to Earth and

286
00:11:06,470 --> 00:11:04,920
that's for potential return to Earth and

287
00:11:08,210 --> 00:11:06,480
that's one part of this Mission that's

288
00:11:11,090 --> 00:11:08,220

particularly interesting so previously

289
00:11:13,310 --> 00:11:11,100
when we've gone to Mars we're trying to

290
00:11:15,949 --> 00:11:13,320
get all the information that we can from

291
00:11:17,750 --> 00:11:15,959
the surface and in this case what we're

292
00:11:19,310 --> 00:11:17,760
doing is there's an opportunity there's

293
00:11:21,769 --> 00:11:19,320
a potential opportunity for us to return

294
00:11:23,329 --> 00:11:21,779
samples back to Earth for further study

295
00:11:24,949 --> 00:11:23,339
and so what we want to do with the

296
00:11:27,230 --> 00:11:24,959
instruments on the Rover is collect all

297
00:11:29,449 --> 00:11:27,240
the data possible so we can decide make

298
00:11:30,769 --> 00:11:29,459
almost a priority list we observe

299
00:11:32,090 --> 00:11:30,779
something here does that look like a

300
00:11:34,670 --> 00:11:32,100
sample we'd want to bring back to Earth

301
00:11:37,009 --> 00:11:34,680
and do further study on if yes collect

302
00:11:38,810 --> 00:11:37,019
and that's something that Sherlock helps

303
00:11:40,310 --> 00:11:38,820
a lot with so it's able to look at all

304
00:11:43,430 --> 00:11:40,320
those different components in Iraq and

305
00:11:45,230 --> 00:11:43,440
figure out are these say minerals that

306
00:11:47,090 --> 00:11:45,240
could preserve organic matter or

307
00:11:48,350 --> 00:11:47,100
potential signs of life really well then

308
00:11:51,170 --> 00:11:48,360
we definitely want to put that at the

309
00:11:53,150 --> 00:11:51,180
top of our list to return so it helps

310
00:11:56,750 --> 00:11:53,160
with that sort of in-situ meaning in

311
00:12:01,250 --> 00:11:58,970
so you talked about all the benefits of

312
00:12:03,829 --> 00:12:01,260
this but how do you tell what you're

313
00:12:06,889 --> 00:12:03,839

specifically looking for how do you find

314
00:12:11,090 --> 00:12:09,110
um so I think it depends on who you are

315
00:12:13,970 --> 00:12:11,100
and exactly what you're looking for with

316
00:12:16,970 --> 00:12:13,980
that so I would say can you go back to

317
00:12:20,630 --> 00:12:16,980
the video that was before this

318
00:12:22,069 --> 00:12:20,640
um yeah exactly so this isn't a braided

319
00:12:24,050 --> 00:12:22,079
patch called Guillaume and I'll use it

320
00:12:25,850 --> 00:12:24,060
as sort of an example here so this is

321
00:12:27,829 --> 00:12:25,860
all the different views that one of the

322
00:12:29,990 --> 00:12:27,839
Sherlock cameras has you're going close

323
00:12:31,790 --> 00:12:30,000
to it and if you're a geologist on the

324
00:12:33,949 --> 00:12:31,800
team versus a mini mineralogist versus

325
00:12:36,050 --> 00:12:33,959
an astrobiologist or a microbiologist

326
00:12:37,910 --> 00:12:36,060
you're going to say you're looking for

327
00:12:39,650 --> 00:12:37,920
something specifically different but

328
00:12:41,750 --> 00:12:39,660
here you can see kind of a wealth of

329
00:12:43,370 --> 00:12:41,760
everything that all of us get to see so

330
00:12:44,930 --> 00:12:43,380
some people search for signs of a

331
00:12:46,069 --> 00:12:44,940
particular mineral so those white

332
00:12:48,290 --> 00:12:46,079
patches that are right in the middle

333
00:12:49,850 --> 00:12:48,300
might pop out to things like say okay

334
00:12:52,790 --> 00:12:49,860
that's quite interesting what does that

335
00:12:55,329 --> 00:12:52,800
look like and in terms of Sherlock data

336
00:12:58,370 --> 00:12:55,339
we would scan a particular part of this

337
00:13:01,129 --> 00:12:58,380
abraded patch and the signs will show up

338
00:13:02,690 --> 00:13:01,139

as Peaks within our Spectra and that we

339
00:13:04,129 --> 00:13:02,700
can match that pattern of Peaks to

340
00:13:06,050 --> 00:13:04,139
standard reference libraries that we

341
00:13:08,569 --> 00:13:06,060
have built here on Earth to classify the

342
00:13:10,670 --> 00:13:08,579
substance and so for me personally I

343
00:13:12,230 --> 00:13:10,680
look for particular types of minerals so

344
00:13:13,790 --> 00:13:12,240
particular Spectra that match with

345
00:13:15,530 --> 00:13:13,800
minerals from reference libraries that

346
00:13:17,449 --> 00:13:15,540
we have that are really good at

347
00:13:18,590 --> 00:13:17,459
preserving organic matter because that's

348
00:13:20,990 --> 00:13:18,600
what I'm interested in as an

349
00:13:25,069 --> 00:13:21,000
astrobiologist so can you go to slide

350
00:13:28,550 --> 00:13:26,629
yeah so I think this is a nice

351
00:13:30,170 --> 00:13:28,560
demonstration of literally what Sherlock

352
00:13:32,750 --> 00:13:30,180
does and this is one of my favorite

353
00:13:34,190 --> 00:13:32,760
examples it's from it's abrasion patch

354
00:13:35,690 --> 00:13:34,200
called Cartier and it's literally like

355
00:13:39,050 --> 00:13:35,700
my phone background because I like it so

356
00:13:42,170 --> 00:13:39,060
much so this is the there we found this

357
00:13:43,970 --> 00:13:42,180
beautiful white sulfate patch so it's

358
00:13:46,610 --> 00:13:43,980
sulfate is a particular type of mineral

359
00:13:47,329 --> 00:13:46,620
that's known on Earth to preserve some

360
00:13:49,370 --> 00:13:47,339
um

361
00:13:52,069 --> 00:13:49,380
they can preserve organic matter and

362
00:13:54,170 --> 00:13:52,079
also potentially biosignatures and so

363
00:13:56,509 --> 00:13:54,180

this one popped out really clearly on

364
00:13:58,430 --> 00:13:56,519
this rock surface and it's also in the

365
00:13:59,810 --> 00:13:58,440
shape of a polar bear so that's also why

366
00:14:01,310 --> 00:13:59,820
we were so excited about it so this is

367
00:14:03,470 --> 00:14:01,320
the knee of the polar bear that's being

368
00:14:05,329 --> 00:14:03,480
scanned and so on the right side you can

369
00:14:07,550 --> 00:14:05,339
see the scan map of Sherlock which is

370
00:14:10,069 --> 00:14:07,560
going over that pencil eraser size area

371
00:14:11,569 --> 00:14:10,079
of the abraded patch and it moves

372
00:14:13,670 --> 00:14:11,579
through Point by Point through a hundred

373
00:14:15,290 --> 00:14:13,680
different points on this scan and at

374
00:14:16,610 --> 00:14:15,300
each point we're collecting Spectra and

375
00:14:18,769 --> 00:14:16,620
that's what you're seeing on the left so

376
00:14:21,350 --> 00:14:18,779
all of these squiggly lines that's

377
00:14:23,210 --> 00:14:21,360
actual information so the position and

378
00:14:24,829 --> 00:14:23,220
the shape of the bumps that you see in

379
00:14:26,990 --> 00:14:24,839
that Spectra that's we're trying to

380
00:14:28,790 --> 00:14:27,000
interpret and so on the left side you

381
00:14:30,889 --> 00:14:28,800
can see how that Spectrum changes as you

382
00:14:32,269 --> 00:14:30,899
move point to point so you analyze all

383
00:14:34,370 --> 00:14:32,279
the Peaks that show up there and then

384
00:14:36,410 --> 00:14:34,380
start asking what material could yield

385
00:14:37,670 --> 00:14:36,420
this signal why is the signal in this

386
00:14:39,710 --> 00:14:37,680
particular place and what does that

387
00:14:41,569 --> 00:14:39,720
match up with how strong is the signal

388
00:14:44,329 --> 00:14:41,579

what sort of colors or Textures in the

389
00:14:46,310 --> 00:14:44,339
rock is it Associated to and if we were

390
00:14:48,170 --> 00:14:46,320
just scanning without mapping figuring

391
00:14:49,610 --> 00:14:48,180
out which signal comes from which part

392
00:14:51,889 --> 00:14:49,620
of the rock would be way more difficult

393
00:14:53,389 --> 00:14:51,899
so here this was a sulfate as I

394
00:14:54,710 --> 00:14:53,399
mentioned and that has that big peak

395
00:14:56,930 --> 00:14:54,720
that's closer to the left side of the

396
00:14:58,670 --> 00:14:56,940
spectrum and then we also see something

397
00:15:00,590 --> 00:14:58,680
that looks like hydration so that bigger

398
00:15:02,629 --> 00:15:00,600
bump that you start seeing on the right

399
00:15:04,550 --> 00:15:02,639
side of the spectrum that's an

400
00:15:05,930 --> 00:15:04,560
indication that this mineral has some

401
00:15:08,629 --> 00:15:05,940
water that's stored in its structure as

402
00:15:12,949 --> 00:15:10,670
it's incredible to think of the things

403
00:15:14,689 --> 00:15:12,959
that Sherlock can show us and tell us

404
00:15:16,129 --> 00:15:14,699
we're going to come back for a few more

405
00:15:18,170 --> 00:15:16,139
questions and continue our conversation

406
00:15:19,490 --> 00:15:18,180
in just a second but I do want to open

407
00:15:21,769 --> 00:15:19,500
it up we've had a ton of questions

408
00:15:23,750 --> 00:15:21,779
online tonight so we're actually going

409
00:15:25,970 --> 00:15:23,760
to let the audience ask the next two or

410
00:15:27,290 --> 00:15:25,980
three questions Sarah what are they

411
00:15:29,930 --> 00:15:27,300
asking out there

412
00:15:32,389 --> 00:15:29,940
okay so a lot of questions are coming in

413
00:15:33,170 --> 00:15:32,399

and I'm having trouble deciding

414
00:15:35,509 --> 00:15:33,180
um

415
00:15:37,910 --> 00:15:35,519
however I liked this one

416
00:15:40,910 --> 00:15:37,920
of many many I like

417
00:15:43,550 --> 00:15:40,920
um so esmo on Instagram asked what is

418
00:15:47,689 --> 00:15:43,560
your number one hope for what we find or

419
00:15:51,710 --> 00:15:49,670
good question also very difficult

420
00:15:53,230 --> 00:15:51,720
question everything's very exciting Okay

421
00:15:55,850 --> 00:15:53,240
so

422
00:15:57,530 --> 00:15:55,860
I think the answer

423
00:15:59,930 --> 00:15:57,540
what I think about the most when I think

424
00:16:02,509 --> 00:15:59,940
about what I would want to see is

425
00:16:05,030 --> 00:16:02,519
diversity so what's a win to me is when

426
00:16:06,829 --> 00:16:05,040
everything doesn't look the same because

427
00:16:08,810 --> 00:16:06,839
that means we're

428
00:16:10,250 --> 00:16:08,820
we're getting the most that we can out

429
00:16:11,569 --> 00:16:10,260
of this trip to Mars and we're hopefully

430
00:16:13,850 --> 00:16:11,579
getting the most of the samples that we

431
00:16:16,069 --> 00:16:13,860
get back so basically I want to see not

432
00:16:17,930 --> 00:16:16,079
just one set of Spectra associated with

433
00:16:19,790 --> 00:16:17,940
one texture and one mineral I want to

434
00:16:20,810 --> 00:16:19,800
see all these different patterns popping

435
00:16:23,090 --> 00:16:20,820
out and that's actually the most

436
00:16:25,129 --> 00:16:23,100
exciting thing I've seen so far is some

437
00:16:26,810 --> 00:16:25,139
of the work that I did is to do the

438
00:16:29,269 --> 00:16:26,820

comparison of what mineral we're seeing

439
00:16:30,829 --> 00:16:29,279
with what sorts of other signals and

440
00:16:32,930 --> 00:16:30,839
we're seeing a huge diversity across

441
00:16:34,610 --> 00:16:32,940
that so I think that's the biggest dream

442
00:16:37,370 --> 00:16:34,620
is that we capture the diversity that

443
00:16:39,350 --> 00:16:37,380
Mars has because I think we're almost on

444
00:16:40,430 --> 00:16:39,360
Earth we think so often of like oh I can

445
00:16:42,530 --> 00:16:40,440
think of 10 different types of

446
00:16:44,569 --> 00:16:42,540
ecosystems and environments and then you

447
00:16:47,030 --> 00:16:44,579
look at pictures of Mars and you can say

448
00:16:50,150 --> 00:16:47,040
like actually if you go to slide three

449
00:16:51,170 --> 00:16:50,160
you can see what the yeah exactly so

450
00:16:53,389 --> 00:16:51,180
when you look at this you might think

451
00:16:55,249 --> 00:16:53,399
like all that stuff looks the same

452
00:16:56,449 --> 00:16:55,259
especially if you haven't been spending

453
00:16:57,650 --> 00:16:56,459
a lot of time looking at Martian rods

454
00:16:59,509 --> 00:16:57,660
you can say hey all that looks the same

455
00:17:01,009 --> 00:16:59,519
why does it matter but then when you

456
00:17:02,509 --> 00:17:01,019
take all the scientific instruments that

457
00:17:04,189 --> 00:17:02,519
we have on the Rover and you look way

458
00:17:05,809 --> 00:17:04,199
more closely at it then you realize

459
00:17:07,250 --> 00:17:05,819
there's so much diversity that's hidden

460
00:17:08,870 --> 00:17:07,260
right behind there so capturing that I

461
00:17:11,929 --> 00:17:08,880
think is the most important and exciting

462
00:17:17,809 --> 00:17:14,990
all right how about another one so udaya

463
00:17:20,449 --> 00:17:17,819

on Facebook asks what if Signs of Life

464
00:17:23,689 --> 00:17:20,459
are not found on the surface would the

465
00:17:26,809 --> 00:17:23,699
subsurface be scanned for life also

466
00:17:29,090 --> 00:17:26,819
that's a great question and uh yes there

467
00:17:30,470 --> 00:17:29,100
are other potential missions that are

468
00:17:31,970 --> 00:17:30,480
being proposed

469
00:17:33,830 --> 00:17:31,980
um that would be looking at the

470
00:17:35,510 --> 00:17:33,840
subsurface instead and

471
00:17:38,450 --> 00:17:35,520
that question I think gets to the heart

472
00:17:39,289 --> 00:17:38,460
of one thing that we're all a little bit

473
00:17:41,090 --> 00:17:39,299
um

474
00:17:43,430 --> 00:17:41,100
that we all go into this field aware of

475
00:17:45,890 --> 00:17:43,440
which is the surface of Mars is not a

476
00:17:47,990 --> 00:17:45,900
really happy environment for Life as we

477
00:17:49,610 --> 00:17:48,000
know it it's pretty harsh because

478
00:17:51,289 --> 00:17:49,620
there's things like UV and ionizing

479
00:17:53,090 --> 00:17:51,299
radiation that are all hitting the

480
00:17:55,370 --> 00:17:53,100
surface so anything that lives there

481
00:17:57,650 --> 00:17:55,380
would have to survive under all of those

482
00:17:59,630 --> 00:17:57,660
conditions and it might be that life

483
00:18:02,029 --> 00:17:59,640
says hey this is too harsh up here we

484
00:18:04,010 --> 00:18:02,039
have to go down to the subsurface and it

485
00:18:06,529 --> 00:18:04,020
might be on the subsurface so yeah we're

486
00:18:09,110 --> 00:18:06,539
appropriately sort of I think um

487
00:18:11,090 --> 00:18:09,120
tuning our expectations that we might

488
00:18:13,070 --> 00:18:11,100

not find all the signs of life on the

489
00:18:17,390 --> 00:18:13,080
surface but maybe future missions can go

490
00:18:23,690 --> 00:18:19,970
should we do one more Nikki absolutely

491
00:18:27,409 --> 00:18:23,700
please sure let's do it so um Ivana on

492
00:18:30,110 --> 00:18:27,419
YouTube is asking so sunanda you

493
00:18:32,270 --> 00:18:30,120
consider yourself an astrobiologist what

494
00:18:34,490 --> 00:18:32,280
are some topics that an astrobiologist

495
00:18:38,150 --> 00:18:34,500
could research on Mars

496
00:18:41,450 --> 00:18:38,160
oh okay so I think do we have all night

497
00:18:43,610 --> 00:18:41,460
no okay I know right all night all day I

498
00:18:45,289 --> 00:18:43,620
want to say a lot of different topics so

499
00:18:47,090 --> 00:18:45,299
I think um

500
00:18:48,230 --> 00:18:47,100
one thing so there's a couple of

501
00:18:49,730 --> 00:18:48,240
different categories that I think an

502
00:18:51,650 --> 00:18:49,740
astrobiologist could look at so one

503
00:18:53,210 --> 00:18:51,660
thing is biosignatures so do we see

504
00:18:55,310 --> 00:18:53,220
anything that could be a potential

505
00:18:58,130 --> 00:18:55,320
biosignature so a potential sign of life

506
00:19:00,409 --> 00:18:58,140
meaning a pattern substance

507
00:19:02,930 --> 00:19:00,419
um or other sort of compound that would

508
00:19:04,549 --> 00:19:02,940
require life for it to be created so

509
00:19:06,710 --> 00:19:04,559
with the tools that we have on the Rover

510
00:19:08,330 --> 00:19:06,720
right now we can say that we could

511
00:19:10,310 --> 00:19:08,340
potentially find what we're calling

512
00:19:11,870 --> 00:19:10,320
potential biosignatures meaning that

513
00:19:13,669 --> 00:19:11,880

these are really interesting we should

514
00:19:15,830 --> 00:19:13,679
bring them back and then decide whether

515
00:19:17,210 --> 00:19:15,840
it's a true biosignature or not so

516
00:19:18,830 --> 00:19:17,220
that's what we can do with the Rover and

517
00:19:20,990 --> 00:19:18,840
that's one area that I think an

518
00:19:22,970 --> 00:19:21,000
astrobiologist could work on another

519
00:19:25,250 --> 00:19:22,980
area is looking for signs of

520
00:19:26,870 --> 00:19:25,260
habitability so on earth when we think

521
00:19:28,730 --> 00:19:26,880
of what would make a good environment

522
00:19:30,890 --> 00:19:28,740
for life to thrive in you think about

523
00:19:33,470 --> 00:19:30,900
like water should be present and

524
00:19:35,570 --> 00:19:33,480
abundant ideally we won't be at the

525
00:19:37,850 --> 00:19:35,580
extremes of pH because then it will be a

526
00:19:40,310 --> 00:19:37,860
sort of milder environment ideally there

527
00:19:42,169 --> 00:19:40,320
wouldn't be an insane amount of UV or

528
00:19:44,870 --> 00:19:42,179
ionizing radiation so life would be able

529
00:19:47,510 --> 00:19:44,880
to thrive there so finding key signals

530
00:19:49,850 --> 00:19:47,520
so particular mineral assemblages or

531
00:19:51,909 --> 00:19:49,860
things like hydration that can help

532
00:19:54,830 --> 00:19:51,919
build the story for what is habitability

533
00:19:56,450 --> 00:19:54,840
habitability so I think those are two

534
00:19:57,650 --> 00:19:56,460
areas that an astrobiologist could work

535
00:19:59,330 --> 00:19:57,660
on

536
00:20:02,930 --> 00:19:59,340
and then there's a lot more too just two

537
00:20:04,549 --> 00:20:02,940
examples that's some great advice uh

538
00:20:06,289 --> 00:20:04,559

keep asking your questions out there we

539
00:20:08,390 --> 00:20:06,299
are going to come back for more but I've

540
00:20:10,789 --> 00:20:08,400
got just a few more questions for our

541
00:20:12,590 --> 00:20:10,799
wonderful speaker this evening so you've

542
00:20:14,270 --> 00:20:12,600
been with perseverance and it's been on

543
00:20:16,730 --> 00:20:14,280
Mars for two years and you touched on

544
00:20:19,909 --> 00:20:16,740
this briefly but what is one of the most

545
00:20:21,830 --> 00:20:19,919
interesting things that you have found

546
00:20:24,710 --> 00:20:21,840
from perseverance

547
00:20:27,890 --> 00:20:24,720
we okay

548
00:20:29,810 --> 00:20:27,900
so I think

549
00:20:31,549 --> 00:20:29,820
okay so I I kind of answered this

550
00:20:34,010 --> 00:20:31,559
earlier in terms of looking at like the

551
00:20:36,549 --> 00:20:34,020
diversity but for me

552
00:20:39,049 --> 00:20:36,559
um so first every time we get data down

553
00:20:40,909 --> 00:20:39,059
I like to get to it as soon as possible

554
00:20:42,289 --> 00:20:40,919
so one of my colleagues who's an

555
00:20:43,789 --> 00:20:42,299
engineering in operations will say hey

556
00:20:45,650 --> 00:20:43,799
the data set is ready and I'll

557
00:20:47,810 --> 00:20:45,660
immediately download it as soon as I can

558
00:20:50,750 --> 00:20:47,820
and the first thing I do is I I usually

559
00:20:53,270 --> 00:20:50,760
flip through all of the Spectra and

560
00:20:54,890 --> 00:20:53,280
images that we have and I try to see

561
00:20:56,630 --> 00:20:54,900
does this look like anything we've seen

562
00:20:57,950 --> 00:20:56,640
before or does this look totally

563
00:20:59,990 --> 00:20:57,960

different than what we've seen before

564
00:21:01,909 --> 00:21:00,000
and when I'm going through all the

565
00:21:04,490 --> 00:21:01,919
different Spectra as they come up I try

566
00:21:06,350 --> 00:21:04,500
to categorize all the different groups

567
00:21:07,850 --> 00:21:06,360
that I would see so I see a particular

568
00:21:09,710 --> 00:21:07,860
peak in this place where I say a

569
00:21:12,409 --> 00:21:09,720
doublet-shaped peak here what does that

570
00:21:14,390 --> 00:21:12,419
mean and then I try to sort of build out

571
00:21:16,370 --> 00:21:14,400
all the diversity and then match it to

572
00:21:18,169 --> 00:21:16,380
each type of texture that we see and

573
00:21:20,390 --> 00:21:18,179
then matching Spectra of Raman and

574
00:21:22,250 --> 00:21:20,400
fluorescence each together so I think

575
00:21:26,570 --> 00:21:22,260
what I personally have seen that's the

576
00:21:28,430 --> 00:21:26,580
most exciting is we're seeing clusters I

577
00:21:31,070 --> 00:21:28,440
would say of particular minerals with

578
00:21:32,330 --> 00:21:31,080
particular fluorescence signatures so

579
00:21:33,890 --> 00:21:32,340
that's one of the types of Spectra that

580
00:21:35,630 --> 00:21:33,900
we collect so with Ramen we're getting

581
00:21:36,770 --> 00:21:35,640
some mineral information and with

582
00:21:39,950 --> 00:21:36,780
fluorescence we're getting a different

583
00:21:41,630 --> 00:21:39,960
type of spectral information and what it

584
00:21:43,010 --> 00:21:41,640
looks like is it isn't everything is

585
00:21:45,110 --> 00:21:43,020
messed with everything there's

586
00:21:46,610 --> 00:21:45,120
particular trends that we're starting to

587
00:21:48,710 --> 00:21:46,620
pick out and we can only start to do

588
00:21:50,450 --> 00:21:48,720

that now so this image that you're

589
00:21:54,890 --> 00:21:50,460
seeing is in the crater floor and if you

590
00:21:59,750 --> 00:21:57,289
this is this was taken as we were moving

591
00:22:01,190 --> 00:21:59,760
into the Delta front area and so to me

592
00:22:02,870 --> 00:22:01,200
what it's looking like from all these

593
00:22:05,270 --> 00:22:02,880
Trends is that the crater floor and the

594
00:22:07,070 --> 00:22:05,280
Delta front don't look the same

595
00:22:08,810 --> 00:22:07,080
and we're seeing sort of hints of this

596
00:22:11,149 --> 00:22:08,820
mineral fluorescence Association as

597
00:22:12,950 --> 00:22:11,159
we're moving through the entire Traverse

598
00:22:14,029 --> 00:22:12,960
of the Rover and I think now we're

599
00:22:15,890 --> 00:22:14,039
finally at the point that we can look

600
00:22:17,930 --> 00:22:15,900
like and say Sherlock has seen 21

601
00:22:19,490 --> 00:22:17,940
different targets so far what are the

602
00:22:21,590 --> 00:22:19,500
bigger picture stories that are showing

603
00:22:22,789 --> 00:22:21,600
up here why aren't we seeing the same

604
00:22:25,549 --> 00:22:22,799
thing everywhere

605
00:22:29,029 --> 00:22:27,350
well that's great so now we've got this

606
00:22:31,970 --> 00:22:29,039
bigger picture idea from perseverance

607
00:22:34,250 --> 00:22:31,980
but what's next for perseverance both in

608
00:22:36,890 --> 00:22:34,260
the immediate and the further out future

609
00:22:40,909 --> 00:22:36,900
for this Rover

610
00:22:41,630 --> 00:22:40,919
so I think we're on Soul 709 yes I think

611
00:22:46,130 --> 00:22:41,640
so

612
00:22:47,510 --> 00:22:46,140
up the Delta front campaign and now the

613
00:22:49,850 --> 00:22:47,520

campaign science leads and the team

614
00:22:51,409 --> 00:22:49,860
overall have planned an excellent Delta

615
00:22:53,149 --> 00:22:51,419
top campaign that we're just starting so

616
00:22:55,430 --> 00:22:53,159
I sort of hinted at this that there's

617
00:22:57,049 --> 00:22:55,440
some minerals that maybe we haven't seen

618
00:22:59,330 --> 00:22:57,059
in such high quantities that hopefully

619
00:23:01,610 --> 00:22:59,340
we'll encounter during this Traverse so

620
00:23:03,529 --> 00:23:01,620
I'll say the short term is I hope to see

621
00:23:05,210 --> 00:23:03,539
something like hydrated silica and

622
00:23:07,130 --> 00:23:05,220
that's a type of mineral that can on

623
00:23:09,049 --> 00:23:07,140
Earth it can preserve signs of life and

624
00:23:10,190 --> 00:23:09,059
organic matter really well so that's

625
00:23:11,750 --> 00:23:10,200
short term something that I'm looking

626
00:23:14,630 --> 00:23:11,760
forward to

627
00:23:16,490 --> 00:23:14,640
um medium term as we move out like maybe

628
00:23:17,810 --> 00:23:16,500
maybe a year from now everything goes

629
00:23:20,090 --> 00:23:17,820
awesomely

630
00:23:22,549 --> 00:23:20,100
um we're going to encounter minerals

631
00:23:24,529 --> 00:23:22,559
that are called carbonates and these

632
00:23:26,390 --> 00:23:24,539
were mapped from orbit like years and

633
00:23:28,310 --> 00:23:26,400
years ago and I've been hearing about

634
00:23:29,510 --> 00:23:28,320
them literally all through my PhD I've

635
00:23:31,730 --> 00:23:29,520
been hearing about the marginal

636
00:23:33,710 --> 00:23:31,740
carbonates and how they would have a lot

637
00:23:35,630 --> 00:23:33,720
of promise for preserving biosinctures

638
00:23:37,750 --> 00:23:35,640

or signs of life and these are in the

639
00:23:39,890 --> 00:23:37,760
Western inner margin of the crater

640
00:23:41,510 --> 00:23:39,900
carbonates are minerals that are found

641
00:23:44,570 --> 00:23:41,520
in a lot of things on earth like in

642
00:23:45,710 --> 00:23:44,580
limestone in shells in hard corals and

643
00:23:47,149 --> 00:23:45,720
they're also found in a bunch of

644
00:23:48,770 --> 00:23:47,159
different rocks that aren't related to

645
00:23:49,850 --> 00:23:48,780
life either but they are great

646
00:23:52,010 --> 00:23:49,860
preservers as I mentioned of

647
00:23:53,810 --> 00:23:52,020
biosignatures so if we encounter that I

648
00:23:55,850 --> 00:23:53,820
think we could find some really exciting

649
00:23:57,649 --> 00:23:55,860
things there and then long term we're

650
00:23:59,690 --> 00:23:57,659
excited about the potential marsample

651
00:24:00,830 --> 00:23:59,700
return campaign so as I mentioned we

652
00:24:02,270 --> 00:24:00,840
collected

653
00:24:04,250 --> 00:24:02,280
um a bunch of different samples so far

654
00:24:06,649 --> 00:24:04,260
so we got nine that were in the crater

655
00:24:08,930 --> 00:24:06,659
floor of rocks and then nine Rock

656
00:24:10,370 --> 00:24:08,940
samples that were from the Delta and if

657
00:24:12,649 --> 00:24:10,380
we can get those samples back to Earth

658
00:24:14,390 --> 00:24:12,659
we're going to get a whole new set of

659
00:24:17,029 --> 00:24:14,400
laboratory data to augment what we

660
00:24:19,370 --> 00:24:17,039
learned from the Rover itself on Mars so

661
00:24:21,169 --> 00:24:19,380
I'm really excited about the potential

662
00:24:22,430 --> 00:24:21,179
of Mars sample return and how much more

663
00:24:24,649 --> 00:24:22,440

information we're going to get because

664
00:24:26,990 --> 00:24:24,659
there's so many tools that I think all

665
00:24:28,909 --> 00:24:27,000
of us wish we had but it's not feasible

666
00:24:30,770 --> 00:24:28,919
to miniaturize them and make them super

667
00:24:32,029 --> 00:24:30,780
robust and send them on a Rover so when

668
00:24:33,770 --> 00:24:32,039
you get these samples back to Earth

669
00:24:36,049 --> 00:24:33,780
we'll be able to do all of those like

670
00:24:38,090 --> 00:24:36,059
high resolution analyzes with you know

671
00:24:39,230 --> 00:24:38,100
equipment that's the size of a room and

672
00:24:41,210 --> 00:24:39,240
we'll be able to get all of this

673
00:24:43,730 --> 00:24:41,220
information down to probably even the

674
00:24:45,770 --> 00:24:43,740
nanometer scale so hopefully if we get

675
00:24:47,330 --> 00:24:45,780
them back and if I'm able to do

676
00:24:49,010 --> 00:24:47,340
everything I need to do to keep working

677
00:24:52,250 --> 00:24:49,020
this field then I hope to be lucky

678
00:24:56,750 --> 00:24:53,990
I think it's just incredible to think

679
00:25:00,049 --> 00:24:56,760
about how much this Rover and Sherlock

680
00:25:02,090 --> 00:25:00,059
have done in two years I mean we are

681
00:25:03,289 --> 00:25:02,100
incredibly excited about the future of

682
00:25:05,450 --> 00:25:03,299
this Mission and what it's already been

683
00:25:07,010 --> 00:25:05,460
able to accomplish so I actually want to

684
00:25:08,750 --> 00:25:07,020
turn it back over to Sarah because I

685
00:25:11,750 --> 00:25:08,760
know the audience has asked you a ton of

686
00:25:13,070 --> 00:25:11,760
questions online so Sarah what else are

687
00:25:15,710 --> 00:25:13,080
they asking out there

688
00:25:19,070 --> 00:25:15,720

all right let's uh look at the question

689
00:25:21,409 --> 00:25:19,080
box here so uh Rosetta on YouTube asks

690
00:25:23,450 --> 00:25:21,419
what is the most surprising thing we've

691
00:25:25,549 --> 00:25:23,460
learned so far from perseverance's

692
00:25:28,010 --> 00:25:25,559
explorations

693
00:25:29,690 --> 00:25:28,020
oh that's probably also going to be a

694
00:25:31,789 --> 00:25:29,700
question that varies based on who you

695
00:25:32,630 --> 00:25:31,799
answer for me

696
00:25:34,970 --> 00:25:32,640
um

697
00:25:37,549 --> 00:25:34,980
so I think

698
00:25:39,110 --> 00:25:37,559
let me see what's most surprising I feel

699
00:25:41,570 --> 00:25:39,120
like there's a lot of surprising things

700
00:25:42,890 --> 00:25:41,580
so okay there's one particular signal

701
00:25:45,590 --> 00:25:42,900
that we've been having a lot of

702
00:25:47,210 --> 00:25:45,600
conversation about within the team and

703
00:25:49,370 --> 00:25:47,220
it could be a couple of different things

704
00:25:53,090 --> 00:25:49,380
and we're literally pushing the

705
00:25:54,890 --> 00:25:53,100
boundaries of what we know so far with

706
00:25:56,750 --> 00:25:54,900
fluorescent spectroscopy and with Raman

707
00:25:58,850 --> 00:25:56,760
spectroscopy to figure out what this

708
00:26:00,710 --> 00:25:58,860
signal could be so it's a signal that we

709
00:26:02,750 --> 00:26:00,720
saw sort of hints of in the crater

710
00:26:04,549 --> 00:26:02,760
floored a couple of points in one rock

711
00:26:05,870 --> 00:26:04,559
that was there and then as you move to

712
00:26:08,149 --> 00:26:05,880
the Delta front we started seeing it

713
00:26:09,710 --> 00:26:08,159

more and more and we're still seeing it

714
00:26:11,510 --> 00:26:09,720
now as we're like making the transition

715
00:26:12,890 --> 00:26:11,520
into the Delta front and I'm curious if

716
00:26:15,110 --> 00:26:12,900
we'll still see it in the Delta front

717
00:26:16,730 --> 00:26:15,120
but yeah that particular signal

718
00:26:19,190 --> 00:26:16,740
literally keeps me up at night it's like

719
00:26:20,930 --> 00:26:19,200
a doublet at 303 and 325 and I'm trying

720
00:26:22,850 --> 00:26:20,940
to think more and more about it so I

721
00:26:24,350 --> 00:26:22,860
think that's a really surprising one

722
00:26:27,230 --> 00:26:24,360
that I don't know exactly what that is

723
00:26:28,789 --> 00:26:27,240
and I'm hoping that we're able to get

724
00:26:30,470 --> 00:26:28,799
these samples back so we can actually do

725
00:26:32,269 --> 00:26:30,480
the full characterization so I'd say

726
00:26:34,190 --> 00:26:32,279
that one was surprising and exciting for

727
00:26:36,169 --> 00:26:34,200
me

728
00:26:37,909 --> 00:26:36,179
all right I'd say I've kind of a related

729
00:26:40,730 --> 00:26:37,919
question to that then

730
00:26:42,890 --> 00:26:40,740
um Travis on LinkedIn is wondering are

731
00:26:45,049 --> 00:26:42,900
you finding minerals and signatures not

732
00:26:49,130 --> 00:26:45,059
currently mapped to Earth's known

733
00:26:50,930 --> 00:26:49,140
minerals and if so what's next

734
00:26:52,549 --> 00:26:50,940
hmm

735
00:26:54,470 --> 00:26:52,559
that's a good question

736
00:26:57,169 --> 00:26:54,480
I think a geologist could give you a

737
00:26:58,789 --> 00:26:57,179
more specific answer from what I

738
00:27:00,710 --> 00:26:58,799

understand so far and all the matching

739
00:27:04,010 --> 00:27:00,720
that I've done with minerals they're

740
00:27:06,350 --> 00:27:04,020
mapped to our reference library so we

741
00:27:08,269 --> 00:27:06,360
can say like okay this is we classify

742
00:27:10,310 --> 00:27:08,279
this minerals as sulfate or carbonate or

743
00:27:12,649 --> 00:27:10,320
a silicate or something like that that

744
00:27:14,870 --> 00:27:12,659
being said not all of them match exactly

745
00:27:16,730 --> 00:27:14,880
perfectly and this is where it starts to

746
00:27:18,049 --> 00:27:16,740
get into a sort of an interesting Gray

747
00:27:20,390 --> 00:27:18,059
Zone which is

748
00:27:21,830 --> 00:27:20,400
the um the instruments on the Rover have

749
00:27:23,690 --> 00:27:21,840
their own limitations right so we might

750
00:27:25,430 --> 00:27:23,700
not be seeing everything in exactly the

751
00:27:27,350 --> 00:27:25,440
perfect spectral resolution that we need

752
00:27:29,510 --> 00:27:27,360
in order to identify a specific mineral

753
00:27:31,490 --> 00:27:29,520
so there's a little bit of like a like a

754
00:27:33,409 --> 00:27:31,500
gray Zone there so not everything will

755
00:27:35,510 --> 00:27:33,419
fit exactly perfectly and that's part of

756
00:27:38,810 --> 00:27:35,520
why we need the samples back but I would

757
00:27:40,730 --> 00:27:38,820
say largely we're seeing what we were

758
00:27:42,289 --> 00:27:40,740
um what we expect to see based on the

759
00:27:44,390 --> 00:27:42,299
reference libraries that we have so

760
00:27:46,430 --> 00:27:44,400
we're able to do matches in most of the

761
00:27:48,710 --> 00:27:46,440
cases

762
00:27:50,990 --> 00:27:48,720
now we've had a couple questions sort of

763
00:27:53,269 --> 00:27:51,000

in a row that are somewhat related to

764
00:27:54,590 --> 00:27:53,279
this and uh this is funny I don't I

765
00:27:57,710 --> 00:27:54,600
think I have heard this question before

766
00:27:59,750 --> 00:27:57,720
but um Billy on Facebook and Arnie on

767
00:28:01,490 --> 00:27:59,760
YouTube asks a similar question which is

768
00:28:05,049 --> 00:28:01,500
about precious metals have we found

769
00:28:06,890 --> 00:28:05,059
anything like gold and silver on Mars

770
00:28:07,549 --> 00:28:06,900
interesting

771
00:28:09,409 --> 00:28:07,559
um

772
00:28:11,390 --> 00:28:09,419
not that I've heard of you can check

773
00:28:12,710 --> 00:28:11,400
with all geologists on the team but the

774
00:28:14,630 --> 00:28:12,720
things that I'm hearing and I guess

775
00:28:17,029 --> 00:28:14,640
maybe it's because of my lens as an

776
00:28:19,490 --> 00:28:17,039
astrobiologist the astrobiologist gold

777
00:28:21,830 --> 00:28:19,500
is minerals that preserve Organics

778
00:28:24,950 --> 00:28:21,840
really really well so for me I'm like

779
00:28:26,690 --> 00:28:24,960
well my goal is a sulfate or my gold is

780
00:28:28,850 --> 00:28:26,700
a hydrated silica and that's why I'm so

781
00:28:30,470 --> 00:28:28,860
excited for the Delta top but yeah I

782
00:28:32,450 --> 00:28:30,480
would say like I don't really know the

783
00:28:34,430 --> 00:28:32,460
exact amounts that we would be expecting

784
00:28:36,169 --> 00:28:34,440
to see on Mars but everything that I've

785
00:28:37,730 --> 00:28:36,179
heard so far is these types of rocks

786
00:28:39,409 --> 00:28:37,740
that we know or these types of minerals

787
00:28:41,570 --> 00:28:39,419
that we know are in igneous rocks from

788
00:28:45,890 --> 00:28:41,580

our studies on like Martian meteorites

789
00:28:51,470 --> 00:28:48,830
all right let's hear from Violet on

790
00:28:54,649 --> 00:28:51,480
Instagram who's asking does perseverance

791
00:28:57,610 --> 00:28:54,659
itself have tools to analyze samples or

792
00:29:00,289 --> 00:28:57,620
can they only be analyzed on Earth

793
00:29:02,510 --> 00:29:00,299
good question so those seven scientific

794
00:29:04,549 --> 00:29:02,520
instruments that I mentioned we can we

795
00:29:07,789 --> 00:29:04,559
do analyze the Rocks as we're finding

796
00:29:09,590 --> 00:29:07,799
them with those and so um what we do is

797
00:29:11,870 --> 00:29:09,600
when I mention those abrasion patches

798
00:29:13,789 --> 00:29:11,880
that's sort of like a proxy for the

799
00:29:16,250 --> 00:29:13,799
actual sample the rock sample that we

800
00:29:17,930 --> 00:29:16,260
pick up so what we do is we use those

801
00:29:19,549 --> 00:29:17,940
instruments to observe right next to

802
00:29:21,049 --> 00:29:19,559
where the sample is picked up so we have

803
00:29:22,490 --> 00:29:21,059
a good understanding of what hopefully

804
00:29:24,110 --> 00:29:22,500
we're actually picking up but those

805
00:29:25,909 --> 00:29:24,120
actual samples that are put in the tubes

806
00:29:27,830 --> 00:29:25,919
themselves those will be fully analyzed

807
00:29:29,930 --> 00:29:27,840
when we bring them back so I would say

808
00:29:31,789 --> 00:29:29,940
the instruments on the Rover do a lot of

809
00:29:34,010 --> 00:29:31,799
analysis and they collect a lot of data

810
00:29:35,389 --> 00:29:34,020
and that is directly applicable to the

811
00:29:38,510 --> 00:29:35,399
samples that we're bringing hopefully

812
00:29:41,930 --> 00:29:40,070
I have another one

813
00:29:44,570 --> 00:29:41,940

um this is a cool one like from an

814
00:29:46,909 --> 00:29:44,580
astrobiology perspective so Sherry on

815
00:29:49,789 --> 00:29:46,919
YouTube is wondering how do you make

816
00:29:51,950 --> 00:29:49,799
sure that you're not concentrating on

817
00:29:53,630 --> 00:29:51,960
finding evidence of life that it would

818
00:29:56,330 --> 00:29:53,640
look like as we know it here on Earth

819
00:29:58,789 --> 00:29:56,340
and that science might miss

820
00:30:00,889 --> 00:29:58,799
Life on Mars

821
00:30:03,230 --> 00:30:00,899
thanks for this question I love thinking

822
00:30:06,710 --> 00:30:03,240
about it actually disaster biology

823
00:30:07,310 --> 00:30:06,720
connection that's such a good one yes so

824
00:30:09,590 --> 00:30:07,320
um

825
00:30:12,110 --> 00:30:09,600
I would say so

826
00:30:13,610 --> 00:30:12,120
we have working hypotheses for what the

827
00:30:15,289 --> 00:30:13,620
definition of

828
00:30:18,350 --> 00:30:15,299
um or a working definition I should say

829
00:30:20,570 --> 00:30:18,360
of what life is and we're guided largely

830
00:30:22,610 --> 00:30:20,580
by what we know about life on Earth

831
00:30:25,250 --> 00:30:22,620
because that's the only example that we

832
00:30:27,350 --> 00:30:25,260
have of a planet that hosts life so

833
00:30:30,350 --> 00:30:27,360
we're definitely limited by that and I

834
00:30:33,289 --> 00:30:30,360
think that's where um having sort of the

835
00:30:36,230 --> 00:30:33,299
agnostic approach and being able to

836
00:30:38,450 --> 00:30:36,240
Clearly say like we're designed to

837
00:30:40,370 --> 00:30:38,460
detect Life as We Know It And there

838
00:30:42,230 --> 00:30:40,380

could be other signs that we are missing

839
00:30:45,529 --> 00:30:42,240
that's always a possibility and I think

840
00:30:47,630 --> 00:30:45,539
anyone who's an astrobiology gets

841
00:30:49,010 --> 00:30:47,640
um they're both aware of that as like a

842
00:30:51,110 --> 00:30:49,020
limitation of our knowledge but also

843
00:30:53,149 --> 00:30:51,120
incredibly excited because that has

844
00:30:54,830 --> 00:30:53,159
started this whole other part of the

845
00:30:57,289 --> 00:30:54,840
field in astrobiology of looking for

846
00:30:59,269 --> 00:30:57,299
agnostic biosignatures so say we're not

847
00:31:01,549 --> 00:30:59,279
looking for exactly the types of

848
00:31:02,930 --> 00:31:01,559
elements like all the things that I just

849
00:31:05,210 --> 00:31:02,940
mentioned about Organics what if we're

850
00:31:07,730 --> 00:31:05,220
not looking for that what else could

851
00:31:09,830 --> 00:31:07,740
life present as and what is a reasonable

852
00:31:11,210 --> 00:31:09,840
thing to search for so this is a newer

853
00:31:17,029 --> 00:31:11,220
part of astrobiology that's still

854
00:31:21,649 --> 00:31:19,669
all right all right all right let's see

855
00:31:24,529 --> 00:31:21,659
this is kind of a personal one

856
00:31:27,289 --> 00:31:24,539
for you sonanda what Richie on Instagram

857
00:31:32,149 --> 00:31:27,299
is asking um what part of this Mission

858
00:31:38,630 --> 00:31:34,130
okay

859
00:31:40,669 --> 00:31:38,640
that was yeah of course your polar bear

860
00:31:42,110 --> 00:31:40,679
was excellent it is my phone background

861
00:31:43,310 --> 00:31:42,120
and like part of the other reason that

862
00:31:45,590 --> 00:31:43,320
one's so exciting just for a second

863
00:31:47,210 --> 00:31:45,600

because you asked is at one of those

864
00:31:49,130 --> 00:31:47,220
particular points like one of the spots

865
00:31:51,110 --> 00:31:49,140
that we analyzed with Sherlock we saw

866
00:31:52,669 --> 00:31:51,120
signs of multiple different minerals all

867
00:31:54,350 --> 00:31:52,679
together and a lot of times we just see

868
00:31:57,529 --> 00:31:54,360
like a single mineral visible through

869
00:31:59,810 --> 00:31:57,539
Ramen so that was really exciting

870
00:32:02,330 --> 00:31:59,820
um and then I would say like that's good

871
00:32:05,990 --> 00:32:02,340
and then another thing would be

872
00:32:10,370 --> 00:32:08,690
I would say the first time that I

873
00:32:12,409 --> 00:32:10,380
actually got to analyze the data myself

874
00:32:15,289 --> 00:32:12,419
because I came in when the mission had

875
00:32:17,210 --> 00:32:15,299
already started so I came in right

876
00:32:18,590 --> 00:32:17,220
around Guillaume so the first time I

877
00:32:20,149 --> 00:32:18,600
looked at that data it was sort of like

878
00:32:22,010 --> 00:32:20,159
I'm still learning what's going on I

879
00:32:23,750 --> 00:32:22,020
have no clear idea of

880
00:32:26,149 --> 00:32:23,760
what all this means and I'm still doing

881
00:32:27,649 --> 00:32:26,159
background reading and and all that sort

882
00:32:29,630 --> 00:32:27,659
of stuff but then the next Target

883
00:32:31,130 --> 00:32:29,640
bellguard that was the first time that I

884
00:32:33,230 --> 00:32:31,140
was like okay this data is coming down

885
00:32:34,970 --> 00:32:33,240
and I'm gonna look at it myself and I

886
00:32:36,710 --> 00:32:34,980
literally printed out every single

887
00:32:38,210 --> 00:32:36,720
picture that we got which was a lot

888
00:32:39,710 --> 00:32:38,220

because we take a lot of pictures with

889
00:32:41,630 --> 00:32:39,720
Sherlock and with all the other cameras

890
00:32:43,370 --> 00:32:41,640
I think we have over 20 cameras on the

891
00:32:45,889 --> 00:32:43,380
Rover I printed out every single picture

892
00:32:47,990 --> 00:32:45,899
of the rock the outcrop that particular

893
00:32:49,490 --> 00:32:48,000
patch and I put them all up in my office

894
00:32:51,889 --> 00:32:49,500
and then I looked through every single

895
00:32:54,470 --> 00:32:51,899
point and for me that was like a

896
00:32:56,029 --> 00:32:54,480
personal exploration and also just so

897
00:32:57,950 --> 00:32:56,039
incredibly exciting that I had all of

898
00:33:02,350 --> 00:32:57,960
this information of Mars just staring at

899
00:33:05,090 --> 00:33:02,360
me in my office so that I would say

900
00:33:07,730 --> 00:33:05,100
okay this is

901
00:33:10,610 --> 00:33:07,740
one that's tugging in my heartstrings so

902
00:33:12,289 --> 00:33:10,620
Mindy on YouTube is wondering um her

903
00:33:14,409 --> 00:33:12,299
three-year-old wants to know if

904
00:33:17,090 --> 00:33:14,419
perseverance will go visit opportunity

905
00:33:18,529 --> 00:33:17,100
his new favorite thing is watching Rover

906
00:33:23,570 --> 00:33:18,539
documentaries

907
00:33:26,389 --> 00:33:23,580
oh that's great oh so

908
00:33:28,190 --> 00:33:26,399
maybe in spirit but in practicality I

909
00:33:29,870 --> 00:33:28,200
don't I don't think so

910
00:33:32,269 --> 00:33:29,880
um and I think part of it is that like

911
00:33:33,769 --> 00:33:32,279
we're exploring a different place but

912
00:33:35,570 --> 00:33:33,779
maybe one thing that would give you

913
00:33:38,149 --> 00:33:35,580

comfort is that all of the information

914
00:33:40,549 --> 00:33:38,159
from all the previous Rovers and this

915
00:33:42,830 --> 00:33:40,559
one this is all coming into one big

916
00:33:44,450 --> 00:33:42,840
picture of our understanding of Mars so

917
00:33:46,730 --> 00:33:44,460
all of that information will get put

918
00:33:48,889 --> 00:33:46,740
together and we're building on the

919
00:33:51,769 --> 00:33:48,899
legacy of all of those previous sorts of

920
00:33:53,570 --> 00:33:51,779
Explorations so we have our plan and

921
00:33:55,789 --> 00:33:53,580
we're going to go through exactly where

922
00:33:57,110 --> 00:33:55,799
we've planned in our Traverse but

923
00:33:58,970 --> 00:33:57,120
keeping all of that previous work in

924
00:34:01,909 --> 00:33:58,980
mind

925
00:34:04,610 --> 00:34:01,919
yep so opportunity might be gone but

926
00:34:06,769 --> 00:34:04,620
certainly not forgotten and as you

927
00:34:08,570 --> 00:34:06,779
mentioned that perseverance is standing

928
00:34:09,829 --> 00:34:08,580
on the shoulders of The Rovers that came

929
00:34:11,149 --> 00:34:09,839
before it

930
00:34:13,369 --> 00:34:11,159
yeah

931
00:34:15,349 --> 00:34:13,379
so Sarah I think we've got time for one

932
00:34:17,869 --> 00:34:15,359
last question from the audience

933
00:34:20,270 --> 00:34:17,879
sounds great okay I have one to bring it

934
00:34:22,790 --> 00:34:20,280
home and this is from reishi on

935
00:34:24,649 --> 00:34:22,800
Instagram saying what advice do you have

936
00:34:27,050 --> 00:34:24,659
sananda for someone interested in the

937
00:34:30,770 --> 00:34:27,060
stem field

938
00:34:36,770 --> 00:34:34,190

I would say that

939
00:34:39,109 --> 00:34:36,780
I think there's a lot of

940
00:34:40,790 --> 00:34:39,119
um emphasis put on like specific paths

941
00:34:43,070 --> 00:34:40,800
to get into stem and make particular

942
00:34:44,570 --> 00:34:43,080
progress to like become a scientist in

943
00:34:46,609 --> 00:34:44,580
this way or an engineer in this way or

944
00:34:49,970 --> 00:34:46,619
things like that and my advice would be

945
00:34:53,750 --> 00:34:49,980
to find your own path because for me

946
00:34:55,430 --> 00:34:53,760
that took a lot of time I did great in

947
00:34:57,349 --> 00:34:55,440
high school and then in college I just

948
00:34:59,270 --> 00:34:57,359
had a really really hard time and I took

949
00:35:00,589 --> 00:34:59,280
all the science and math classes and all

950
00:35:03,050 --> 00:35:00,599
that kind of stuff and it just wasn't

951
00:35:04,970 --> 00:35:03,060
clicking for me and I had really bad

952
00:35:06,890 --> 00:35:04,980
grades until I started to figure out

953
00:35:09,050 --> 00:35:06,900
like what do I need to do to learn and

954
00:35:10,910 --> 00:35:09,060
for me it was research I needed to be in

955
00:35:13,430 --> 00:35:10,920
a lab and finding out new things and

956
00:35:15,170 --> 00:35:13,440
thinking creatively and so that's how I

957
00:35:16,970 --> 00:35:15,180
was able to reconcile the art that I did

958
00:35:19,010 --> 00:35:16,980
and the music that I played and the

959
00:35:20,569 --> 00:35:19,020
design that I wanted to do with the

960
00:35:23,150 --> 00:35:20,579
science that I wanted to do is doing

961
00:35:25,490 --> 00:35:23,160
creative research so for me that was a

962
00:35:27,770 --> 00:35:25,500
path towards stem and I would always say

963
00:35:30,109 --> 00:35:27,780

like stem plus art is is incredible

964
00:35:32,270 --> 00:35:30,119
that's what I always love to do so don't

965
00:35:34,069 --> 00:35:32,280
be restrictive about how you want to

966
00:35:35,810 --> 00:35:34,079
approach them make it work for you

967
00:35:39,230 --> 00:35:35,820
because you deserve to be in the field

968
00:35:41,510 --> 00:35:39,240
if you want to be there that's it

969
00:35:43,430 --> 00:35:41,520
and if I could add you know you've

970
00:35:44,690 --> 00:35:43,440
worked on perseverance you've been able

971
00:35:46,490 --> 00:35:44,700
to do all these incredible things with

972
00:35:48,349 --> 00:35:46,500
Sherlock because you've had the

973
00:35:50,750 --> 00:35:48,359
perseverance to do them and so that's

974
00:35:52,190 --> 00:35:50,760
some great advice to really persevere to

975
00:35:53,750 --> 00:35:52,200
our audience

976
00:35:55,849 --> 00:35:53,760
um unfortunately folks that is all the

977
00:35:57,650 --> 00:35:55,859
time we have for this evening I want to

978
00:36:00,290 --> 00:35:57,660
take a moment to thank our speaker Dr

979
00:36:03,349 --> 00:36:00,300
sananda Sharma for joining us to discuss

980
00:36:05,150 --> 00:36:03,359
two years of perseverance I also want to

981
00:36:07,190 --> 00:36:05,160
thank our wonderful questions co-host

982
00:36:08,930 --> 00:36:07,200
Sarah Marcotte and everyone working

983
00:36:11,030 --> 00:36:08,940
behind the scenes to make this possible

984
00:36:12,829 --> 00:36:11,040
make sure you check out the link Sarah

985
00:36:15,290 --> 00:36:12,839
mentioned earlier to get more

986
00:36:18,849 --> 00:36:15,300
information about the two years of

987
00:36:23,870 --> 00:36:18,859
perseverance that link again is Mars dot

988
00:36:25,670 --> 00:36:23,880

nasa.gov forward slash Mars 2020. to all

989
00:36:27,829 --> 00:36:25,680
of you watching thank you for taking the

990
00:36:29,630 --> 00:36:27,839
time to join us every month if you

991
00:36:31,370 --> 00:36:29,640
missed one or would like to revisit any

992
00:36:33,829 --> 00:36:31,380
of our Von Carmen talks from the past

993
00:36:36,410 --> 00:36:33,839
five years they are all available on

994
00:36:38,630 --> 00:36:36,420
jpl's YouTube page and please be sure to

995
00:36:42,710 --> 00:36:38,640
join us next month for exploring ocean

996
00:36:45,109 --> 00:36:42,720
worlds with eels exobiology extent life

997
00:36:46,849 --> 00:36:45,119
surveyor that's all for tonight folks

998
00:36:49,520 --> 00:36:46,859
thanks and bye everyone have a great

999
00:37:02,510 --> 00:37:00,730
[Music]