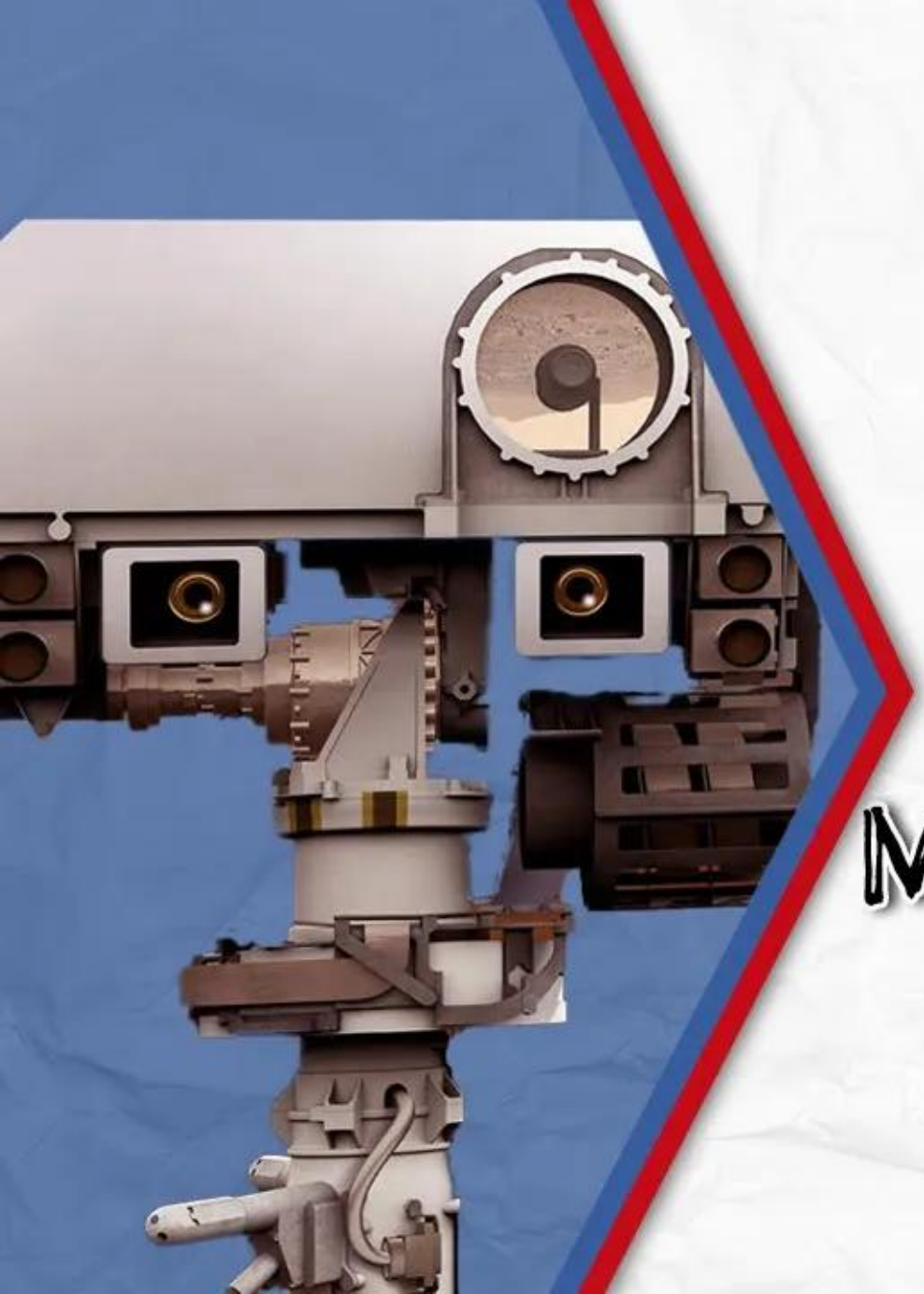

Ask An Astrobiologist

Episode 38: February 2nd, 2021

Mars 2020 Panel Episode

NASA Astrobiology Program

1
00:00:00,680 --> 00:00:30,310
[Music]

2
00:00:33,750 --> 00:00:31,029
greetings

3
00:00:35,670 --> 00:00:33,760
friends and fellow humans and maybe even

4
00:00:38,389 --> 00:00:35,680
potential future martians

5
00:00:40,229 --> 00:00:38,399
and welcome to ask an astrobiologist the

6
00:00:42,950 --> 00:00:40,239
show that celebrates the science

7
00:00:43,990 --> 00:00:42,960
and celebrates the scientists involved

8
00:00:46,470 --> 00:00:44,000
in our quest to

9
00:00:47,590 --> 00:00:46,480
understand the nature of life i'm your

10
00:00:49,590 --> 00:00:47,600
host graham lau

11
00:00:51,029 --> 00:00:49,600
also known online as the professor of

12
00:00:52,470 --> 00:00:51,039
everything groovy

13
00:00:54,310 --> 00:00:52,480

and we're brought to you by the nasa

14
00:00:57,350 --> 00:00:54,320
astrobiology program

15
00:00:58,150 --> 00:00:57,360
and saginet.org which by the way second

16
00:01:02,069 --> 00:00:58,160
net is now

17
00:01:03,510 --> 00:01:02,079
10 years old this year so 2021 is a big

18
00:01:05,350 --> 00:01:03,520
moment for sagging that

19
00:01:06,789 --> 00:01:05,360
uh thanks to everyone over the years for

20
00:01:08,230 --> 00:01:06,799
all your support for all the things that

21
00:01:09,830 --> 00:01:08,240
we've done trying to

22
00:01:12,310 --> 00:01:09,840
help early career scientists in

23
00:01:16,070 --> 00:01:12,320
astrobiology get involved in carrying

24
00:01:19,270 --> 00:01:16,080
astrobiology forward into the future

25
00:01:21,109 --> 00:01:19,280
now this is our first episode of 2021

26
00:01:22,310 --> 00:01:21,119
and it's got some red planet awesomeness

27
00:01:23,910 --> 00:01:22,320
that i think we're all really

28
00:01:26,310 --> 00:01:23,920
excited to talk about in case you didn't

29
00:01:27,190 --> 00:01:26,320
know within the next three weeks we have

30
00:01:29,830 --> 00:01:27,200
three missions

31
00:01:30,630 --> 00:01:29,840
arriving at mars the hope mission from

32
00:01:33,109 --> 00:01:30,640
the uae

33
00:01:35,429 --> 00:01:33,119
is arriving in orbit here on the 9th on

34
00:01:37,350 --> 00:01:35,439
the 10th of february tn1

35
00:01:39,429 --> 00:01:37,360
will be arriving at mars as well it has

36
00:01:42,149 --> 00:01:39,439
a rover that we're looking at a may

37
00:01:43,590 --> 00:01:42,159
touchdown on mars and then maybe most

38
00:01:46,630 --> 00:01:43,600

importantly for many of us

39
00:01:49,109 --> 00:01:46,640
percy or nasa's perseverance rover is

40
00:01:50,069 --> 00:01:49,119
scheduled to land on mars on the 18th of

41
00:01:51,830 --> 00:01:50,079
this month

42
00:01:53,429 --> 00:01:51,840
and so we have a very special panel

43
00:01:56,389 --> 00:01:53,439
episode to talk about

44
00:01:58,389 --> 00:01:56,399
mars astrobiology about curiosity about

45
00:01:59,830 --> 00:01:58,399
perseverance and ingenuity

46
00:02:01,510 --> 00:01:59,840
about the instruments and all the

47
00:02:04,230 --> 00:02:01,520
science that's going into

48
00:02:05,910 --> 00:02:04,240
this landing and all the research ahead

49
00:02:07,270 --> 00:02:05,920
sample return and all these other

50
00:02:09,190 --> 00:02:07,280
awesome things

51
00:02:11,510 --> 00:02:09,200
but before we get there as many of you

52
00:02:12,630 --> 00:02:11,520
know we have our ambassador of the month

53
00:02:14,309 --> 00:02:12,640
to announce

54
00:02:16,790 --> 00:02:14,319
every single month we like to point out

55
00:02:18,790 --> 00:02:16,800
the people who've done the most work on

56
00:02:20,869 --> 00:02:18,800
twitter and other social media platforms

57
00:02:23,910 --> 00:02:20,879
and email and websites to

58
00:02:25,270 --> 00:02:23,920
share information about our show and get

59
00:02:26,949 --> 00:02:25,280
the word out there

60
00:02:28,550 --> 00:02:26,959
and this month we'd like to point out

61
00:02:30,550 --> 00:02:28,560
four users from twitter

62
00:02:32,710 --> 00:02:30,560
who did a great job sharing information

63
00:02:34,070 --> 00:02:32,720

about the show helping us to advertise

64
00:02:35,990 --> 00:02:34,080
and just showing some ask an

65
00:02:39,350 --> 00:02:36,000
astrobiologist love

66
00:02:42,390 --> 00:02:39,360
these are users at space nasim

67
00:02:46,630 --> 00:02:42,400
at azul pinoba and

68
00:02:49,190 --> 00:02:46,640
at strayologists and at just grelda

69
00:02:50,070 --> 00:02:49,200
all long time uh watchers observers of

70
00:02:52,630 --> 00:02:50,080
our show

71
00:02:54,470 --> 00:02:52,640
and now spaceness nasim uh whose real

72
00:02:56,309 --> 00:02:54,480
name is miriam nassim

73
00:02:57,990 --> 00:02:56,319
is also now helping in the background

74
00:02:59,430 --> 00:02:58,000
along with sarah treadwell

75
00:03:01,270 --> 00:02:59,440
uh i also want to give a huge shout out

76
00:03:03,110 --> 00:03:01,280
to mike toyon our producer and director

77
00:03:05,750 --> 00:03:03,120
and sanjoy song for helping us run this

78
00:03:07,990 --> 00:03:05,760
show and keep things lively

79
00:03:10,149 --> 00:03:08,000
now without any further ado let's bring

80
00:03:11,350 --> 00:03:10,159
in our guest for this very special panel

81
00:03:13,190 --> 00:03:11,360
episode

82
00:03:14,790 --> 00:03:13,200
first off we have francis rivera

83
00:03:18,470 --> 00:03:14,800
hernandez

84
00:03:20,229 --> 00:03:18,480
geologist

85
00:03:21,990 --> 00:03:20,239
who very recently transitioned from a

86
00:03:22,790 --> 00:03:22,000
postdoctoral position at dartmouth

87
00:03:24,949 --> 00:03:22,800
college

88
00:03:26,309 --> 00:03:24,959

into now becoming an assistant professor

89
00:03:28,470 --> 00:03:26,319
at georgia tech

90
00:03:29,670 --> 00:03:28,480
dr rivera hernandez uses a mixture of

91
00:03:32,550 --> 00:03:29,680
field research

92
00:03:34,949 --> 00:03:32,560
remote sensing and numerical analyses to

93
00:03:36,869 --> 00:03:34,959
reconstruct paleo environments

94
00:03:38,550 --> 00:03:36,879
interpreting things like paleoclimate

95
00:03:40,869 --> 00:03:38,560
and paleohydrology

96
00:03:42,070 --> 00:03:40,879
and the habitability of planetary bodies

97
00:03:43,990 --> 00:03:42,080
uh so francis

98
00:03:46,309 --> 00:03:44,000
hi and thank you welcome to ask an

99
00:03:49,430 --> 00:03:46,319
astrobiologist thank you graeme

100
00:03:51,270 --> 00:03:49,440
excited to be here and nerdy about mars

101
00:03:53,589 --> 00:03:51,280
um so i mean paleo climate paleo

102
00:03:54,550 --> 00:03:53,599
hydrology paleo environments there's

103
00:03:55,670 --> 00:03:54,560
lots of things that you're learning

104
00:03:57,030 --> 00:03:55,680
about the past

105
00:03:58,869 --> 00:03:57,040
uh could you quickly give like a

106
00:04:01,830 --> 00:03:58,879
synopsis of the kind of research that

107
00:04:04,229 --> 00:04:01,840
you do for our audience

108
00:04:04,949 --> 00:04:04,239
yeah sure so a lot of my work as you

109
00:04:07,110 --> 00:04:04,959
alluded to

110
00:04:09,190 --> 00:04:07,120
is focused on characterizing the

111
00:04:12,390 --> 00:04:09,200
surfaces of planetary bodies

112
00:04:14,630 --> 00:04:12,400
specifically mars and for that i use a

113
00:04:17,670 --> 00:04:14,640

lot of data from the curiosity rover

114
00:04:20,789 --> 00:04:17,680
and uh really trying to uh use

115
00:04:22,950 --> 00:04:20,799
the rock record to reconstruct what

116
00:04:24,550 --> 00:04:22,960
uh past environments or parallel

117
00:04:25,189 --> 00:04:24,560
environments were present on mars in the

118
00:04:27,110 --> 00:04:25,199
past

119
00:04:28,230 --> 00:04:27,120
and i also do a lot of field work on

120
00:04:29,909 --> 00:04:28,240
earth in

121
00:04:31,430 --> 00:04:29,919
uh analog environments so environments

122
00:04:33,110 --> 00:04:31,440
that we think might be similar to those

123
00:04:35,350 --> 00:04:33,120
that were present on mars to

124
00:04:36,310 --> 00:04:35,360
better interpret the data that uh we get

125
00:04:38,950 --> 00:04:36,320
from uh

126
00:04:39,990 --> 00:04:38,960
missions and so um that's i guess

127
00:04:43,030 --> 00:04:40,000
essentially what i do

128
00:04:44,870 --> 00:04:43,040
and um again excited to be here

129
00:04:46,469 --> 00:04:44,880
awesome it's great to have you and we're

130
00:04:48,469 --> 00:04:46,479
going to talk a lot about mars

131
00:04:49,590 --> 00:04:48,479
environments and analog environments

132
00:04:51,909 --> 00:04:49,600
here on earth

133
00:04:53,350 --> 00:04:51,919
with all three of you our next guest is

134
00:04:55,550 --> 00:04:53,360
dr kenda lynch

135
00:04:56,950 --> 00:04:55,560
dr lynch is an astrobiologist and

136
00:04:58,629 --> 00:04:56,960
geomicrobiologist

137
00:05:00,710 --> 00:04:58,639
she's worked as a systems engineer for

138
00:05:02,710 --> 00:05:00,720

the international space station program

139
00:05:04,310 --> 00:05:02,720
and as a research engineer for the astro

140
00:05:05,430 --> 00:05:04,320
materials exploration science

141
00:05:06,870 --> 00:05:05,440
directorate

142
00:05:09,590 --> 00:05:06,880
both of which are at nasa's johnson

143
00:05:11,830 --> 00:05:09,600
space center dr lynch currently studies

144
00:05:12,390 --> 00:05:11,840
life in extreme places on earth in these

145
00:05:14,390 --> 00:05:12,400
analog

146
00:05:16,150 --> 00:05:14,400
environments as models for

147
00:05:17,350 --> 00:05:16,160
characterizing habitable environments

148
00:05:18,550 --> 00:05:17,360
and searching for life on other

149
00:05:20,710 --> 00:05:18,560
planetary bodies

150
00:05:23,110 --> 00:05:20,720
uh kenda welcome thanks for joining us

151
00:05:24,790 --> 00:05:23,120
uh and welcome to ask an astrobiologist

152
00:05:26,550 --> 00:05:24,800
thank you it's so great to be here i'm

153
00:05:28,790 --> 00:05:26,560
really excited to be on the show

154
00:05:29,670 --> 00:05:28,800
especially with francis and and our next

155
00:05:31,590 --> 00:05:29,680
guest vet it's

156
00:05:32,710 --> 00:05:31,600
it's just an honor to be here i'm so

157
00:05:34,070 --> 00:05:32,720
glad to have you and you

158
00:05:35,909 --> 00:05:34,080
we've known each other for a very long

159
00:05:37,670 --> 00:05:35,919
time now you and i uh

160
00:05:40,230 --> 00:05:37,680
since back in our earliest days here in

161
00:05:41,510 --> 00:05:40,240
colorado uh quite long ago but one thing

162
00:05:42,390 --> 00:05:41,520
i never really had a chance to chat with

163
00:05:44,870 --> 00:05:42,400

you about

164
00:05:46,710 --> 00:05:44,880
was this transition in your career from

165
00:05:48,950 --> 00:05:46,720
engineering kind of focused work into

166
00:05:49,510 --> 00:05:48,960
more of the geomicrobiology the geology

167
00:05:50,790 --> 00:05:49,520
work

168
00:05:52,310 --> 00:05:50,800
uh could you speak to our audience a

169
00:05:54,070 --> 00:05:52,320
little bit about that pathway of

170
00:05:56,390 --> 00:05:54,080
engineering into geology

171
00:05:57,510 --> 00:05:56,400
um sure so i i started out in human

172
00:05:59,189 --> 00:05:57,520
space flight

173
00:06:00,629 --> 00:05:59,199
and i really liked i really liked what i

174
00:06:03,670 --> 00:06:00,639
was doing i was working on developing

175
00:06:04,309 --> 00:06:03,680
human habitation systems um for space

176
00:06:05,749 --> 00:06:04,319
station

177
00:06:07,670 --> 00:06:05,759
and you know and eventually working on

178
00:06:09,670 --> 00:06:07,680
things for future human spaceflight but

179
00:06:11,029 --> 00:06:09,680
i'd always really enjoyed the the

180
00:06:12,070 --> 00:06:11,039
diffusion between engineering and

181
00:06:13,189 --> 00:06:12,080
science and especially using my

182
00:06:16,390 --> 00:06:13,199
biological

183
00:06:17,710 --> 00:06:16,400
skills and i learned about astrobiology

184
00:06:19,510 --> 00:06:17,720
and this whole area of

185
00:06:21,189 --> 00:06:19,520
astrobiotechnology and using our

186
00:06:23,909 --> 00:06:21,199
advances in biotechnology

187
00:06:25,270 --> 00:06:23,919
to help us do more research for looking

188
00:06:26,070 --> 00:06:25,280

for life in the universe and i just got

189
00:06:27,350 --> 00:06:26,080
very

190
00:06:28,870 --> 00:06:27,360
impassioned about that and an

191
00:06:29,830 --> 00:06:28,880
opportunity came up at johnson space

192
00:06:32,950 --> 00:06:29,840
center to work

193
00:06:34,469 --> 00:06:32,960
um with the now deceased david mckay

194
00:06:36,629 --> 00:06:34,479
who's one of our senior

195
00:06:37,749 --> 00:06:36,639
you know um astrobiologists and

196
00:06:40,790 --> 00:06:37,759
well-known in the field

197
00:06:42,870 --> 00:06:40,800
and uh i took it and um they can

198
00:06:43,830 --> 00:06:42,880
they convinced me to go back to grad

199
00:06:45,350 --> 00:06:43,840
school um

200
00:06:46,469 --> 00:06:45,360
i i got to spend about four years

201
00:06:47,350 --> 00:06:46,479
working at johnson space center

202
00:06:50,230 --> 00:06:47,360
developing

203
00:06:51,589 --> 00:06:50,240
um technologies to help us improve our

204
00:06:52,309 --> 00:06:51,599
abilities to look for life on other

205
00:06:53,670 --> 00:06:52,319
planets

206
00:06:55,589 --> 00:06:53,680
and then i just got really interested in

207
00:06:56,870 --> 00:06:55,599
the science side of it and then

208
00:06:58,629 --> 00:06:56,880
decided to go back to grad school to

209
00:07:00,870 --> 00:06:58,639
kind of focus on that so it was a

210
00:07:02,469 --> 00:07:00,880
it was a really fun transition i still

211
00:07:04,390 --> 00:07:02,479
sometimes get to put my engineering hat

212
00:07:06,469 --> 00:07:04,400
on when we develop instruments

213
00:07:08,070 --> 00:07:06,479

both here at lpi and with other

214
00:07:09,670 --> 00:07:08,080
collaborators so it's it's

215
00:07:14,790 --> 00:07:09,680
it's kind of fun to be able to wear both

216
00:07:17,670 --> 00:07:16,230
that's awesome i think i had a little

217
00:07:18,710 --> 00:07:17,680
pause there that's okay we just lost to

218
00:07:20,550 --> 00:07:18,720
the very end

219
00:07:21,830 --> 00:07:20,560
um it's so good to have you here kenda

220
00:07:23,510 --> 00:07:21,840
and we're gonna talk a lot about your

221
00:07:24,950 --> 00:07:23,520
careers i imagine we'll have questions

222
00:07:26,629 --> 00:07:24,960
from our audience who are watching right

223
00:07:28,550 --> 00:07:26,639
now on seganet.org and the nasa

224
00:07:29,990 --> 00:07:28,560
astrobiology facebook page

225
00:07:31,909 --> 00:07:30,000
uh those questions will come through the

226
00:07:33,749 --> 00:07:31,919
teleprompter to me for later

227
00:07:35,430 --> 00:07:33,759
uh and i'm sure we'll have some about

228
00:07:37,430 --> 00:07:35,440
your careers as well

229
00:07:40,469 --> 00:07:37,440
uh and then our third guest on the panel

230
00:07:42,070 --> 00:07:40,479
today is doctors vetlana shkolyar

231
00:07:43,430 --> 00:07:42,080
zvet and i have also known each other

232
00:07:45,110 --> 00:07:43,440
for quite some time and i've known her

233
00:07:46,710 --> 00:07:45,120
both as a researcher and as a

234
00:07:48,309 --> 00:07:46,720
communicator of science

235
00:07:49,749 --> 00:07:48,319
uh dr scholiar is currently a

236
00:07:51,589 --> 00:07:49,759
postdoctoral fellow at

237
00:07:54,070 --> 00:07:51,599
a fellow at nasa's goddard space flight

238
00:07:56,230 --> 00:07:54,080

center and she works on life detection

239
00:07:58,150 --> 00:07:56,240
techniques for planetary surfaces using

240
00:08:00,950 --> 00:07:58,160
laser spectroscopy

241
00:08:01,270 --> 00:08:00,960
her work also involves studies informing

242
00:08:04,869 --> 00:08:01,280
the

243
00:08:07,589 --> 00:08:04,879
sample return for

244
00:08:09,350 --> 00:08:07,599
the perseverance rover zvet is also

245
00:08:11,189 --> 00:08:09,360
passionate about cycom

246
00:08:13,430 --> 00:08:11,199
sharing science empowering the next

247
00:08:15,029 --> 00:08:13,440
generation of planetary explorers

248
00:08:18,309 --> 00:08:15,039
uh so is vet welcome to ask an

249
00:08:24,070 --> 00:08:20,309
thank you graeme it is an honor to be

250
00:08:25,589 --> 00:08:24,080
here with some of my favorite people

251
00:08:27,189 --> 00:08:25,599
yeah i mean you and i have also known

252
00:08:28,469 --> 00:08:27,199
each other for quite some time

253
00:08:29,909 --> 00:08:28,479
you've also done a lot of work in

254
00:08:31,670 --> 00:08:29,919
science education and science

255
00:08:33,350 --> 00:08:31,680
communication through saginet

256
00:08:34,949 --> 00:08:33,360
i wonder for our audience if you can

257
00:08:35,829 --> 00:08:34,959
just speak uh briefly about the

258
00:08:37,670 --> 00:08:35,839
importance

259
00:08:40,389 --> 00:08:37,680
of not just doing science but also

260
00:08:43,110 --> 00:08:40,399
sharing science yeah

261
00:08:44,870 --> 00:08:43,120
um absolutely i mean it's it's such a

262
00:08:45,590 --> 00:08:44,880
privilege to be doing this kind of

263
00:08:49,030 --> 00:08:45,600

science

264
00:08:49,829 --> 00:08:49,040
and i i just feel like our job is not

265
00:08:52,630 --> 00:08:49,839
complete

266
00:08:53,350 --> 00:08:52,640
if we don't you know excite the public

267
00:08:55,190 --> 00:08:53,360
about it and

268
00:08:56,870 --> 00:08:55,200
and within the field of astrobiology

269
00:09:00,550 --> 00:08:56,880
it's such it's it's just such

270
00:09:02,790 --> 00:09:00,560
an uh

271
00:09:03,910 --> 00:09:02,800
grossing narrative you know for life out

272
00:09:05,509 --> 00:09:03,920
there i feel we all

273
00:09:07,190 --> 00:09:05,519
since since the time we're kids we're

274
00:09:10,150 --> 00:09:07,200
all excited about this topic

275
00:09:12,150 --> 00:09:10,160
and and just being able to excite people

276
00:09:13,590 --> 00:09:12,160
about that every opportunity i can i

277
00:09:15,590 --> 00:09:13,600
think is just

278
00:09:17,190 --> 00:09:15,600
um one of my favorite parts of the job

279
00:09:18,630 --> 00:09:17,200
honestly

280
00:09:20,310 --> 00:09:18,640
awesome yeah when you're in love you

281
00:09:23,269 --> 00:09:20,320
have to tell the world right

282
00:09:24,550 --> 00:09:23,279
um and so uh we had a lot of a lot of

283
00:09:26,790 --> 00:09:24,560
love for this episode

284
00:09:28,550 --> 00:09:26,800
on twitter and facebook and instagram

285
00:09:29,750 --> 00:09:28,560
and linkedin all over the place i heard

286
00:09:31,030 --> 00:09:29,760
a lot of people talking about it there

287
00:09:33,750 --> 00:09:31,040
was a lot of buzz

288
00:09:35,750 --> 00:09:33,760

uh and the nasa astro bio at nasa astro

289
00:09:38,150 --> 00:09:35,760
bio account on twitter

290
00:09:40,230 --> 00:09:38,160
shared some polls some questions for

291
00:09:41,829 --> 00:09:40,240
their very large audience on twitter

292
00:09:43,590 --> 00:09:41,839
about the upcoming mission to mars with

293
00:09:46,310 --> 00:09:43,600
perseverance and

294
00:09:47,829 --> 00:09:46,320
upcoming mars research one question that

295
00:09:49,750 --> 00:09:47,839
we ask people

296
00:09:51,910 --> 00:09:49,760
so that perseverance looks a lot like

297
00:09:54,230 --> 00:09:51,920
curiosity they have the same chassis

298
00:09:55,829 --> 00:09:54,240
they're very similar looking but we

299
00:09:58,070 --> 00:09:55,839
asked we asked the audience if they know

300
00:09:59,350 --> 00:09:58,080
what makes the missions different

301
00:10:02,069 --> 00:09:59,360
and we had a few answers we wanted to

302
00:10:03,110 --> 00:10:02,079
point out uh anna rupante who is at

303
00:10:04,550 --> 00:10:03,120
strayologist

304
00:10:06,310 --> 00:10:04,560
said that perseverance is going to

305
00:10:07,590 --> 00:10:06,320
collect samples and drop them

306
00:10:09,430 --> 00:10:07,600
so they can be brought back to earth

307
00:10:11,110 --> 00:10:09,440
through a sample return mission

308
00:10:12,790 --> 00:10:11,120
and that's true that's a very big thing

309
00:10:14,710 --> 00:10:12,800
is sample return from mars i think a lot

310
00:10:17,110 --> 00:10:14,720
of us want to talk about that

311
00:10:18,150 --> 00:10:17,120
camille who goes by at kilo underscore

312
00:10:19,509 --> 00:10:18,160
mora

313
00:10:21,750 --> 00:10:19,519

said that she can't wait to see

314
00:10:22,630 --> 00:10:21,760
ingenuity fly and listen to the winds of

315
00:10:26,470 --> 00:10:22,640
mars

316
00:10:28,150 --> 00:10:26,480
and listening to the sound

317
00:10:29,910 --> 00:10:28,160
engaging with it in a human way and

318
00:10:32,389 --> 00:10:29,920
flying a drone around

319
00:10:33,910 --> 00:10:32,399
is going to be cool and then user at

320
00:10:36,150 --> 00:10:33,920
justgrelda

321
00:10:37,829 --> 00:10:36,160
said curiosity is a great rover but it

322
00:10:38,949 --> 00:10:37,839
isn't an astrobiologist like

323
00:10:43,190 --> 00:10:38,959
perseverance

324
00:10:45,430 --> 00:10:43,200
ancient life or modern life on mars

325
00:10:46,990 --> 00:10:45,440
and that's that's that's true uh

326
00:10:49,190 --> 00:10:47,000
perseverance is an

327
00:10:51,430 --> 00:10:49,200
astrobiologist robot and that's that's

328
00:10:53,190 --> 00:10:51,440
pretty cool for all of us to talk about

329
00:10:54,790 --> 00:10:53,200
uh so francis i wanted to bring a

330
00:10:57,430 --> 00:10:54,800
question to you because of this

331
00:10:58,630 --> 00:10:57,440
you worked on curiosity um what do you

332
00:11:00,790 --> 00:10:58,640
think were the successes

333
00:11:01,670 --> 00:11:00,800
of the curiosity mission what we learned

334
00:11:03,670 --> 00:11:01,680
from that mission

335
00:11:05,829 --> 00:11:03,680
and and how will perseverance build on

336
00:11:09,269 --> 00:11:05,839
those successes

337
00:11:10,630 --> 00:11:09,279
yeah so uh curiosity landed back in 2012

338
00:11:12,790 --> 00:11:10,640

and it's still an active mission so i

339
00:11:15,590 --> 00:11:12,800
would say that it has a lot of successes

340
00:11:16,550 --> 00:11:15,600
um however um i think one of the main

341
00:11:19,910 --> 00:11:16,560
successes has

342
00:11:23,269 --> 00:11:19,920
uh uh has been actually uh achieving

343
00:11:24,710 --> 00:11:23,279
the main uh uh goal of the mission which

344
00:11:25,990 --> 00:11:24,720
was to identify and characterize

345
00:11:28,550 --> 00:11:26,000
habitable environments

346
00:11:29,350 --> 00:11:28,560
on mars in particular in gale crater and

347
00:11:33,430 --> 00:11:29,360
uh

348
00:11:34,790 --> 00:11:33,440
deposits of rivers

349
00:11:37,110 --> 00:11:34,800
which provide evidence for running

350
00:11:38,389 --> 00:11:37,120
liquid water and also the deposits of

351
00:11:39,670 --> 00:11:38,399
lakes which provide evidence for

352
00:11:41,190 --> 00:11:39,680
sustained liquid water

353
00:11:43,030 --> 00:11:41,200
and lakes in particular are important

354
00:11:45,190 --> 00:11:43,040
because they are

355
00:11:46,710 --> 00:11:45,200
possibly stable uh water environments

356
00:11:49,910 --> 00:11:46,720
where life could have

357
00:11:52,389 --> 00:11:49,920
persisted or evolved on mars surface and

358
00:11:53,590 --> 00:11:52,399
uh with curiosity we know that uh some

359
00:11:55,990 --> 00:11:53,600
of these lakes could have been present

360
00:11:57,829 --> 00:11:56,000
on mars for tens of thousands to uh

361
00:12:00,230 --> 00:11:57,839
millions of years and so

362
00:12:01,430 --> 00:12:00,240
um so with perseverance you know we're

363
00:12:02,150 --> 00:12:01,440

taking this a little step further

364
00:12:04,230 --> 00:12:02,160
instead of

365
00:12:06,069 --> 00:12:04,240
uh you know only uh characterizing and

366
00:12:07,750 --> 00:12:06,079
identifying habitable environments

367
00:12:10,069 --> 00:12:07,760
we're asking the next obvious question

368
00:12:12,550 --> 00:12:10,079
which is um what's their actual

369
00:12:13,990 --> 00:12:12,560
microbial life on mars in the past and

370
00:12:15,190 --> 00:12:14,000
so all of the instruments on

371
00:12:17,509 --> 00:12:15,200
perseverance

372
00:12:18,550 --> 00:12:17,519
were selected specifically to answer uh

373
00:12:20,710 --> 00:12:18,560
that question

374
00:12:21,829 --> 00:12:20,720
and with that which you alluded to uh

375
00:12:24,870 --> 00:12:21,839
recently is

376
00:12:25,590 --> 00:12:24,880
the sample return uh part of the mission

377
00:12:29,110 --> 00:12:25,600
which

378
00:12:31,190 --> 00:12:29,120
uh will uh core uh rocks that we think

379
00:12:33,910 --> 00:12:31,200
might have uh biosignatures so this

380
00:12:34,629 --> 00:12:33,920
evidence for for past life in the form

381
00:12:38,870 --> 00:12:34,639
of

382
00:12:40,629 --> 00:12:38,880
fossilized cells and organics

383
00:12:42,710 --> 00:12:40,639
and uh hopefully storing that for a

384
00:12:44,949 --> 00:12:42,720
future mission to to return

385
00:12:46,389 --> 00:12:44,959
and then um i also wanted to say also

386
00:12:47,509 --> 00:12:46,399
from an engineering side since the

387
00:12:50,230 --> 00:12:47,519
landing's gonna be happening

388
00:12:52,230 --> 00:12:50,240

happening uh soon that uh one of the

389
00:12:54,150 --> 00:12:52,240
novel things with curiosity was

390
00:12:55,829 --> 00:12:54,160
the landing system which we call the sky

391
00:12:57,509 --> 00:12:55,839
crane which uh

392
00:12:59,269 --> 00:12:57,519
consisted of a platform that hovered

393
00:13:02,230 --> 00:12:59,279
over the surface and

394
00:13:02,870 --> 00:13:02,240
um slowly lowered the rover onto the

395
00:13:04,470 --> 00:13:02,880
ground

396
00:13:05,990 --> 00:13:04,480
and so with perseverance we're going to

397
00:13:08,710 --> 00:13:06,000
be using a similar technique

398
00:13:11,190 --> 00:13:08,720
but it's updated and so uh it will be

399
00:13:12,389 --> 00:13:11,200
using on automated system to be able to

400
00:13:15,350 --> 00:13:12,399
detect hazards

401
00:13:17,430 --> 00:13:15,360
and land the rovers safely and so from

402
00:13:19,509 --> 00:13:17,440
an engineering perspective

403
00:13:20,790 --> 00:13:19,519
we'll also will be advancing some of the

404
00:13:23,110 --> 00:13:20,800
successes that we've had

405
00:13:24,550 --> 00:13:23,120
um with curiosity among other things

406
00:13:26,949 --> 00:13:24,560
that are you know novel with with

407
00:13:28,550 --> 00:13:26,959
perseverance compared with curiosity but

408
00:13:30,629 --> 00:13:28,560
i'm assuming we'll be talking uh more

409
00:13:32,069 --> 00:13:30,639
about that uh throughout the episode

410
00:13:34,069 --> 00:13:32,079
yeah we'll definitely talk about all the

411
00:13:35,509 --> 00:13:34,079
instruments and things on board

412
00:13:37,190 --> 00:13:35,519
and i really hadn't thought much about

413
00:13:39,350 --> 00:13:37,200

changes in the sky crane system

414
00:13:41,430 --> 00:13:39,360
i will admit i was one of those

415
00:13:43,590 --> 00:13:41,440
naysayers who was naysaying

416
00:13:45,110 --> 00:13:43,600
before curiosity went to mars i was

417
00:13:46,470 --> 00:13:45,120
really worried the sky crane wasn't

418
00:13:49,509 --> 00:13:46,480
going to work

419
00:13:51,269 --> 00:13:49,519
it was an amazing feat of engineering uh

420
00:13:52,710 --> 00:13:51,279
for curiosity and it will be for for

421
00:13:54,069 --> 00:13:52,720
perseverance as well and so i hope

422
00:13:56,389 --> 00:13:54,079
everyone when they're watching

423
00:13:58,230 --> 00:13:56,399
the landing understands that during that

424
00:13:59,269 --> 00:13:58,240
period of silence when the rover is

425
00:14:01,030 --> 00:13:59,279
landing that's

426
00:14:02,949 --> 00:14:01,040
a really important time that a lot of

427
00:14:04,470 --> 00:14:02,959
lines of code are running through that

428
00:14:06,069 --> 00:14:04,480
system to make that landing system

429
00:14:09,430 --> 00:14:06,079
actually function correctly

430
00:14:11,910 --> 00:14:09,440
uh it's a beautiful feat of engineering

431
00:14:12,629 --> 00:14:11,920
so we had another question on twitter as

432
00:14:14,310 --> 00:14:12,639
well

433
00:14:16,150 --> 00:14:14,320
uh we asked people you know percy is

434
00:14:17,750 --> 00:14:16,160
heading to jezreel crater

435
00:14:19,590 --> 00:14:17,760
and as france has just eluded you know

436
00:14:21,430 --> 00:14:19,600
we're looking for signs of life you know

437
00:14:23,590 --> 00:14:21,440
past the present life using this

438
00:14:25,189 --> 00:14:23,600

this rover and so we asked people why

439
00:14:26,710 --> 00:14:25,199
jezreel a crater

440
00:14:28,310 --> 00:14:26,720
uh and so we had a few people who

441
00:14:29,750 --> 00:14:28,320
pointed out that there are dry lake

442
00:14:30,470 --> 00:14:29,760
basins with high potential for

443
00:14:33,189 --> 00:14:30,480
preserving

444
00:14:34,629 --> 00:14:33,199
signatures of life bio signatures uh so

445
00:14:35,509 --> 00:14:34,639
four of our winners from this

446
00:14:39,269 --> 00:14:35,519
competition

447
00:14:43,670 --> 00:14:39,279
we wanted to highlight are at space fia

448
00:14:44,470 --> 00:14:43,680
at najarika hopare at endless underscore

449
00:14:47,829 --> 00:14:44,480
forms

450
00:14:49,670 --> 00:14:47,839
and at eduardo acopres1

451
00:14:51,269 --> 00:14:49,680
uh so thank you very much for everyone

452
00:14:53,269 --> 00:14:51,279
who answered that question on the at

453
00:14:54,870 --> 00:14:53,279
nasa astrobio twitter account

454
00:14:56,790 --> 00:14:54,880
uh it's always great to see all of you

455
00:14:57,990 --> 00:14:56,800
interacting and those of you who really

456
00:15:00,870 --> 00:14:58,000
know what's going on right now

457
00:15:01,670 --> 00:15:00,880
with this landing site um and my next

458
00:15:03,110 --> 00:15:01,680
question then

459
00:15:04,870 --> 00:15:03,120
kenda since i know that you were

460
00:15:06,150 --> 00:15:04,880
involved in landing site selection in

461
00:15:08,150 --> 00:15:06,160
the workshops

462
00:15:09,670 --> 00:15:08,160
uh and you you know a lot about jezreel

463
00:15:10,470 --> 00:15:09,680

crater i was wondering if you could tell

464
00:15:12,949 --> 00:15:10,480
our audience

465
00:15:15,030 --> 00:15:12,959
really why jezreel was selected as the

466
00:15:17,269 --> 00:15:15,040
landing site for perseverance

467
00:15:18,790 --> 00:15:17,279
um absolutely so as francis said you

468
00:15:20,470 --> 00:15:18,800
know one of the things that

469
00:15:21,990 --> 00:15:20,480
that we looked at that and we've really

470
00:15:24,150 --> 00:15:22,000
been able to learn about even more from

471
00:15:25,990 --> 00:15:24,160
curiosity in a lot of our orbital

472
00:15:27,990 --> 00:15:26,000
investigations is we've been able to see

473
00:15:30,069 --> 00:15:28,000
and find and characterize places where

474
00:15:31,509 --> 00:15:30,079
um we have physical signs that liquid

475
00:15:33,829 --> 00:15:31,519
water either flowed

476
00:15:35,430 --> 00:15:33,839
or was sustained and with jezreel we

477
00:15:37,430 --> 00:15:35,440
have both

478
00:15:39,670 --> 00:15:37,440
we have this beautiful crater that has

479
00:15:40,550 --> 00:15:39,680
this gorgeous delta system that told us

480
00:15:43,509 --> 00:15:40,560
that

481
00:15:45,430 --> 00:15:43,519
water flowed from the channel into this

482
00:15:46,230 --> 00:15:45,440
beautiful paleo lake basin and was

483
00:15:47,829 --> 00:15:46,240
stayed for

484
00:15:49,590 --> 00:15:47,839
a long enough period of time to make

485
00:15:51,990 --> 00:15:49,600
this beautiful delta deposit

486
00:15:52,710 --> 00:15:52,000
and the and the um the lake floor

487
00:15:53,990 --> 00:15:52,720
deposit

488
00:15:55,749 --> 00:15:54,000

of which some of it we can access some

489
00:15:57,590 --> 00:15:55,759
of it we really can't access

490
00:15:59,590 --> 00:15:57,600
um and what makes jezreel so wonderful

491
00:16:02,069 --> 00:15:59,600
is because we have that delta deposit

492
00:16:03,829 --> 00:16:02,079
that tells us that we both had um you

493
00:16:04,389 --> 00:16:03,839
know water flowing and sustaining the

494
00:16:07,430 --> 00:16:04,399
lake

495
00:16:09,350 --> 00:16:07,440
we have a multitude of um

496
00:16:11,350 --> 00:16:09,360
potential astro um habitable

497
00:16:13,590 --> 00:16:11,360
environments that we can

498
00:16:15,509 --> 00:16:13,600
look for biosignatures from we have

499
00:16:17,189 --> 00:16:15,519
environments within the lake itself

500
00:16:19,189 --> 00:16:17,199
and we have access to potential

501
00:16:20,710 --> 00:16:19,199
preserved preserved biosignatures from

502
00:16:21,430 --> 00:16:20,720
environments that were maybe upstream

503
00:16:23,749 --> 00:16:21,440
from the lake

504
00:16:24,629 --> 00:16:23,759
and were flowed in and dropped into the

505
00:16:26,870 --> 00:16:24,639
lake bed and then

506
00:16:27,990 --> 00:16:26,880
preserved there so we have just a whole

507
00:16:30,150 --> 00:16:28,000
beautiful host

508
00:16:31,350 --> 00:16:30,160
of potential places where we could get

509
00:16:33,030 --> 00:16:31,360
bio signatures from

510
00:16:34,550 --> 00:16:33,040
so the key ones in the lake themselves

511
00:16:36,069 --> 00:16:34,560
there are two key places that we really

512
00:16:37,670 --> 00:16:36,079
want to look in the lake themselves

513
00:16:39,350 --> 00:16:37,680

for biosignatures that could have been

514
00:16:39,910 --> 00:16:39,360
formed maybe even potentially in the

515
00:16:41,990 --> 00:16:39,920
lake

516
00:16:43,269 --> 00:16:42,000
um one of them the big one that a lot of

517
00:16:44,710 --> 00:16:43,279
the scientists are excited about

518
00:16:46,389 --> 00:16:44,720
are these what they're calling these

519
00:16:48,790 --> 00:16:46,399
marginal carbonates and it's another

520
00:16:50,949 --> 00:16:48,800
reason that jezreel crater is so amazing

521
00:16:51,910 --> 00:16:50,959
kind of up on the um delta rim and on

522
00:16:55,670 --> 00:16:51,920
the rim of the crater

523
00:16:58,069 --> 00:16:55,680
we have this huge area of actual um

524
00:16:58,870 --> 00:16:58,079
where we actually detected magnesium

525
00:17:02,230 --> 00:16:58,880
carbonates

526
00:17:03,590 --> 00:17:02,240
are hard to detect and we're seeing it

527
00:17:05,350 --> 00:17:03,600
and because we're seeing it that means

528
00:17:07,669 --> 00:17:05,360
there's a lot of it there

529
00:17:10,069 --> 00:17:07,679
and usually on earth when we see these

530
00:17:13,669 --> 00:17:10,079
kind of things like in lakes and in

531
00:17:14,870 --> 00:17:13,679
um or even on um kind of like in coastal

532
00:17:16,870 --> 00:17:14,880
coastal areas

533
00:17:18,630 --> 00:17:16,880
um they tend to be places that harbor

534
00:17:21,510 --> 00:17:18,640
what we call microbial lights

535
00:17:22,789 --> 00:17:21,520
and these are actual um um carbonate

536
00:17:25,909 --> 00:17:22,799
sedimentary structures that

537
00:17:28,150 --> 00:17:25,919
are um made by and inhabited by

538
00:17:30,150 --> 00:17:28,160

microorganisms and especially in lake

539
00:17:32,310 --> 00:17:30,160
environments on earth that are very very

540
00:17:33,669 --> 00:17:32,320
salty hyper ceiling lakes like the great

541
00:17:34,870 --> 00:17:33,679
salt lake which is right next to my

542
00:17:37,110 --> 00:17:34,880
field environment

543
00:17:38,310 --> 00:17:37,120
we see these kind of microbial lights

544
00:17:40,789 --> 00:17:38,320
right on the lake shores

545
00:17:42,470 --> 00:17:40,799
all the time and so scientists are

546
00:17:46,070 --> 00:17:42,480
really excited that what we're seeing

547
00:17:48,310 --> 00:17:46,080
may be remnants of microbial

548
00:17:49,909 --> 00:17:48,320
lights that that grew in the jezreel

549
00:17:51,270 --> 00:17:49,919
crater paleo lake system when there was

550
00:17:52,070 --> 00:17:51,280
still water there so that's one of the

551
00:17:54,390 --> 00:17:52,080
biggest sites

552
00:17:55,990 --> 00:17:54,400
we're the most excited about the other

553
00:17:58,950 --> 00:17:56,000
site that we're excited about is the

554
00:17:59,270 --> 00:17:58,960
um delta bottom set deposits these are

555
00:18:01,669 --> 00:17:59,280
these

556
00:18:03,590 --> 00:18:01,679
really fine grain deposits that are like

557
00:18:06,310 --> 00:18:03,600
the last things basically to drop

558
00:18:07,430 --> 00:18:06,320
out of the the water that is entering

559
00:18:09,750 --> 00:18:07,440
the the lake from

560
00:18:10,789 --> 00:18:09,760
the the channel system that is basically

561
00:18:12,390 --> 00:18:10,799
feeding it so

562
00:18:14,070 --> 00:18:12,400
these sediments are the last things to

563
00:18:15,510 --> 00:18:14,080

drop out and they're really fine

564
00:18:18,310 --> 00:18:15,520
and they're really tiny and they're

565
00:18:20,390 --> 00:18:18,320
really good at one binding to organics

566
00:18:22,070 --> 00:18:20,400
and two preserving organics so we're

567
00:18:24,310 --> 00:18:22,080
really interested in that site because

568
00:18:27,029 --> 00:18:24,320
that is a great place where

569
00:18:28,870 --> 00:18:27,039
any kind of biosignature any kind of

570
00:18:29,990 --> 00:18:28,880
organic bio signature that maybe had

571
00:18:31,909 --> 00:18:30,000
come from

572
00:18:33,909 --> 00:18:31,919
a habitable environment that was

573
00:18:36,390 --> 00:18:33,919
upstream of the lake

574
00:18:37,990 --> 00:18:36,400
and got captured or dumped into the

575
00:18:38,470 --> 00:18:38,000
flowing water and then flowed into the

576
00:18:40,230 --> 00:18:38,480
lake

577
00:18:42,070 --> 00:18:40,240
it could have been trapped there down

578
00:18:43,909 --> 00:18:42,080
there and stored there for

579
00:18:45,430 --> 00:18:43,919
the many millions of years it's been

580
00:18:46,950 --> 00:18:45,440
sitting in those lake bed deposits so

581
00:18:48,150 --> 00:18:46,960
we're very excited to look at those

582
00:18:49,909 --> 00:18:48,160
deposits as well

583
00:18:51,669 --> 00:18:49,919
so those are two of the big places that

584
00:18:53,750 --> 00:18:51,679
we're really excited to look

585
00:18:55,110 --> 00:18:53,760
um for biosignatures in jezreel and

586
00:18:55,750 --> 00:18:55,120
there and there are some other possible

587
00:18:57,029 --> 00:18:55,760
places

588
00:18:58,950 --> 00:18:57,039

on the delta plane where we could have

589
00:19:00,230 --> 00:18:58,960
had spring deposits there's just

590
00:19:02,310 --> 00:19:00,240
there's just so much diversity in

591
00:19:03,990 --> 00:19:02,320
jezreel for possible habitable

592
00:19:05,830 --> 00:19:04,000
um environments then that's why we

593
00:19:06,230 --> 00:19:05,840
really are excited to get there and to

594
00:19:11,029 --> 00:19:06,240
get

595
00:19:12,310 --> 00:19:11,039
started looking that's so groovy

596
00:19:13,990 --> 00:19:12,320
yeah and for all those watching i mean

597
00:19:15,110 --> 00:19:14,000
we always have multiple potential

598
00:19:16,950 --> 00:19:15,120
landing sites that we're looking at

599
00:19:18,390 --> 00:19:16,960
there are lots of really cool places on

600
00:19:20,230 --> 00:19:18,400
mars to explore

601
00:19:21,669 --> 00:19:20,240
jezreel won because of these these

602
00:19:23,270 --> 00:19:21,679
interesting features

603
00:19:25,110 --> 00:19:23,280
uh and so i think a lot of us are

604
00:19:26,230 --> 00:19:25,120
excited for percy to get going inside of

605
00:19:27,669 --> 00:19:26,240
jezreel crater

606
00:19:29,830 --> 00:19:27,679
uh and there's a lot of exciting things

607
00:19:31,590 --> 00:19:29,840
about this mission uh zvet i wanted to

608
00:19:33,669 --> 00:19:31,600
bring you in next then uh and just tell

609
00:19:34,390 --> 00:19:33,679
us what excites you the most about this

610
00:19:35,990 --> 00:19:34,400
mission

611
00:19:39,430 --> 00:19:36,000
and maybe even for the future of mars

612
00:19:41,750 --> 00:19:39,440
exploration because of this mission

613
00:19:44,150 --> 00:19:41,760

yeah um well we know that the

614
00:19:45,830 --> 00:19:44,160
perseverance rover kind of

615
00:19:48,150 --> 00:19:45,840
on the surface looks a lot like

616
00:19:49,669 --> 00:19:48,160
curiosity right the skeleton and

617
00:19:51,830 --> 00:19:49,679
it seems like you know oh what's new

618
00:19:53,750 --> 00:19:51,840
with special but really perseverance

619
00:19:56,230 --> 00:19:53,760
rover represents the first step

620
00:19:57,029 --> 00:19:56,240
of mars sample return i mean this is

621
00:19:59,510 --> 00:19:57,039
something that

622
00:20:01,029 --> 00:19:59,520
we in the astrobiology community have

623
00:20:03,350 --> 00:20:01,039
been waiting for

624
00:20:04,630 --> 00:20:03,360
for a long time and preparing for for a

625
00:20:06,870 --> 00:20:04,640
long time

626
00:20:07,750 --> 00:20:06,880
this mission is not only going to

627
00:20:09,909 --> 00:20:07,760
understand

628
00:20:11,029 --> 00:20:09,919
the habitable environments in jezreel

629
00:20:13,590 --> 00:20:11,039
where it will

630
00:20:15,190 --> 00:20:13,600
search for signs of life but it is also

631
00:20:20,470 --> 00:20:15,200
intended to

632
00:20:23,270 --> 00:20:20,480
samples that may actually preserve

633
00:20:23,830 --> 00:20:23,280
ancient signs of life study those

634
00:20:26,870 --> 00:20:23,840
samples

635
00:20:27,750 --> 00:20:26,880
in detail do a ton of documentation and

636
00:20:29,750 --> 00:20:27,760
if it

637
00:20:31,590 --> 00:20:29,760
if the science team determines that yes

638
00:20:34,710 --> 00:20:31,600

this could be a potential

639
00:20:35,350 --> 00:20:34,720
signature of life a potential bio

640
00:20:37,830 --> 00:20:35,360
signature

641
00:20:39,270 --> 00:20:37,840
then that rock is going to be cored and

642
00:20:41,590 --> 00:20:39,280
cached into a container

643
00:20:43,510 --> 00:20:41,600
that is going to be sealed very very

644
00:20:47,190 --> 00:20:43,520
tightly what we call hermetically

645
00:20:47,830 --> 00:20:47,200
and stored in this um very complex

646
00:20:49,669 --> 00:20:47,840
system

647
00:20:50,710 --> 00:20:49,679
it's going to have this carousel and

648
00:20:51,990 --> 00:20:50,720
then it's going to be you know the

649
00:20:53,350 --> 00:20:52,000
sample is going to be imaged and then

650
00:20:56,230 --> 00:20:53,360
it's going to be stored in this

651
00:20:57,990 --> 00:20:56,240
um sample caching system and then

652
00:20:58,870 --> 00:20:58,000
another uh sample fetch rover is going

653
00:21:01,750 --> 00:20:58,880
to come back

654
00:21:02,310 --> 00:21:01,760
in the future uh pick up those samples

655
00:21:04,470 --> 00:21:02,320
and

656
00:21:05,669 --> 00:21:04,480
eventually potentially bring them back

657
00:21:07,909 --> 00:21:05,679
to earth

658
00:21:09,830 --> 00:21:07,919
that is the the campaign that we call

659
00:21:12,950 --> 00:21:09,840
the mars sample return campaign

660
00:21:15,990 --> 00:21:12,960
and in order for us to

661
00:21:19,510 --> 00:21:16,000
really do good astrobiology we

662
00:21:22,070 --> 00:21:19,520
want to have those samples back on earth

663
00:21:23,029 --> 00:21:22,080

we want to have those cache samples so

664
00:21:25,110 --> 00:21:23,039
we can study them

665
00:21:26,470 --> 00:21:25,120
in the high resolution laboratories here

666
00:21:28,789 --> 00:21:26,480
on earth and

667
00:21:30,390 --> 00:21:28,799
perseverance really represents the first

668
00:21:33,909 --> 00:21:30,400
step of that three-part

669
00:21:36,630 --> 00:21:33,919
campaign so i'm just really excited to

670
00:21:38,230 --> 00:21:36,640
um see what kind of samples we come

671
00:21:41,510 --> 00:21:38,240
across and cash and

672
00:21:42,630 --> 00:21:41,520
and you know maybe a decade from now it

673
00:21:45,830 --> 00:21:42,640
said that um

674
00:21:48,149 --> 00:21:45,840
as early as the early 2030s uh we may

675
00:21:49,190 --> 00:21:48,159
be able to get the samples back maybe a

676
00:21:51,669 --> 00:21:49,200
little bit later

677
00:21:52,870 --> 00:21:51,679
so um you know in our lifetimes we will

678
00:21:56,390 --> 00:21:52,880
see those samples

679
00:21:58,310 --> 00:21:56,400
uh return to earth for study

680
00:22:00,870 --> 00:21:58,320
of potential signs of life with high

681
00:22:03,270 --> 00:22:00,880
resolution equipment here on earth

682
00:22:04,549 --> 00:22:03,280
yeah i really hope so for myself i've

683
00:22:06,310 --> 00:22:04,559
done a bunch of research using

684
00:22:07,190 --> 00:22:06,320
synchrotrons these these large particle

685
00:22:08,310 --> 00:22:07,200
accelerators

686
00:22:10,470 --> 00:22:08,320
and i remember when i was when i was

687
00:22:10,950 --> 00:22:10,480
working on them i'm like i can't take a

688
00:22:12,630 --> 00:22:10,960

giant

689
00:22:14,390 --> 00:22:12,640
synchrotron to mars but we can bring

690
00:22:15,669 --> 00:22:14,400
samples back and we can look at it that

691
00:22:17,430 --> 00:22:15,679
way so

692
00:22:19,270 --> 00:22:17,440
i think a lot of us are super hopeful

693
00:22:20,789 --> 00:22:19,280
for bringing those samples back

694
00:22:22,390 --> 00:22:20,799
and then we also have a lot of really

695
00:22:25,270 --> 00:22:22,400
cool instruments that are going to be

696
00:22:27,270 --> 00:22:25,280
on percy so another poll question we put

697
00:22:28,390 --> 00:22:27,280
out through the at nasa astrobio twitter

698
00:22:29,909 --> 00:22:28,400
account

699
00:22:32,149 --> 00:22:29,919
we said there's a bunch of incredible

700
00:22:35,990 --> 00:22:32,159
instruments but maybe of

701
00:22:38,230 --> 00:22:36,000
pixel rimfax sherlock and supercam

702
00:22:39,190 --> 00:22:38,240
what's your favorite astrobiology

703
00:22:42,710 --> 00:22:39,200
instrument

704
00:22:46,789 --> 00:22:42,720
and we had over 614 votes on that tweet

705
00:22:50,230 --> 00:22:46,799
uh and sherlock won with about 39

706
00:22:52,390 --> 00:22:50,240
votes um sherlock is going to be a ramon

707
00:22:53,270 --> 00:22:52,400
spectrometer uh which i'm very excited

708
00:22:54,549 --> 00:22:53,280
about i know zvet

709
00:22:56,710 --> 00:22:54,559
is as well since she has a lot of

710
00:22:58,310 --> 00:22:56,720
experience in raman and i think many of

711
00:22:59,990 --> 00:22:58,320
us in the geo community are super

712
00:23:01,990 --> 00:23:00,000
excited about having raman spectrometers

713
00:23:03,270 --> 00:23:02,000

going to mars now as well

714
00:23:05,029 --> 00:23:03,280
and so this kind of brought to mind for

715
00:23:06,710 --> 00:23:05,039
me just a really quick rapid fire

716
00:23:08,549 --> 00:23:06,720
question for each of you

717
00:23:09,750 --> 00:23:08,559
um is maybe what is your favorite

718
00:23:11,909 --> 00:23:09,760
instrument and why

719
00:23:13,510 --> 00:23:11,919
in in like one simple sentence say you

720
00:23:15,110 --> 00:23:13,520
were talking to a high school student

721
00:23:16,950 --> 00:23:15,120
and you had to explain in one sentence

722
00:23:18,710 --> 00:23:16,960
why that instrument is awesome

723
00:23:21,430 --> 00:23:18,720
uh what would it be uh so francis i

724
00:23:23,190 --> 00:23:21,440
think i think we'll start with you

725
00:23:24,789 --> 00:23:23,200
uh so seeing as i'm part of the camp

726
00:23:26,630 --> 00:23:24,799
camp team which is on the curiosity

727
00:23:28,549 --> 00:23:26,640
rover i would have to say

728
00:23:30,070 --> 00:23:28,559
that super cam is my favorite instrument

729
00:23:31,590 --> 00:23:30,080
it's like come on it has lasers that we

730
00:23:34,070 --> 00:23:31,600
can use to zap rocks

731
00:23:35,510 --> 00:23:34,080
uh on another planet and of course it's

732
00:23:37,350 --> 00:23:35,520
gonna have a microphone which

733
00:23:38,950 --> 00:23:37,360
you also talked about earlier which you

734
00:23:41,269 --> 00:23:38,960
know will give us the ability to

735
00:23:43,590 --> 00:23:41,279
you know listen to to you know the

736
00:23:45,909 --> 00:23:43,600
sounds of mars for the first time and so

737
00:23:46,630 --> 00:23:45,919
um yeah that to me is my favorite

738
00:23:47,909 --> 00:23:46,640

instrument

739
00:23:49,750 --> 00:23:47,919
that is pretty cool i i love the

740
00:23:51,669 --> 00:23:49,760
pictures we have from curiosity of like

741
00:23:53,190 --> 00:23:51,679
lasers popping out and cats jumping off

742
00:23:55,350 --> 00:23:53,200
the surface of mars i imagine

743
00:23:56,630 --> 00:23:55,360
we're gonna have those as well for percy

744
00:23:57,909 --> 00:23:56,640
uh kenda how about you

745
00:23:59,510 --> 00:23:57,919
what's what's your favorite instrument

746
00:24:01,669 --> 00:23:59,520
or an awesome instrument and maybe in

747
00:24:03,909 --> 00:24:01,679
like one simple sentence why

748
00:24:05,830 --> 00:24:03,919
well i do love sherlock i'm so excited

749
00:24:07,430 --> 00:24:05,840
with charlotte but i have to admit that

750
00:24:08,870 --> 00:24:07,440
one of my favorite instruments that i'm

751
00:24:11,909 --> 00:24:08,880
really excited about too is

752
00:24:12,230 --> 00:24:11,919
pixel because pixel is going to let us

753
00:24:14,549 --> 00:24:12,240
do

754
00:24:15,669 --> 00:24:14,559
things um as like as gm as a

755
00:24:17,110 --> 00:24:15,679
geomicrobiologist

756
00:24:19,029 --> 00:24:17,120
i'm so excited that i'll be able that's

757
00:24:22,470 --> 00:24:19,039
something i do in the lab a lot

758
00:24:25,269 --> 00:24:22,480
to look um to look at the structure of

759
00:24:26,230 --> 00:24:25,279
my stamp of my samples that i take from

760
00:24:27,990 --> 00:24:26,240
my environment

761
00:24:29,830 --> 00:24:28,000
i'll be able to do on mars and that and

762
00:24:31,269 --> 00:24:29,840
that pixel will let us not only take

763
00:24:31,990 --> 00:24:31,279

pictures and look at tiny little

764
00:24:34,630 --> 00:24:32,000
structures

765
00:24:35,990 --> 00:24:34,640
but it's all actually can map literally

766
00:24:37,590 --> 00:24:36,000
pixel by pixel

767
00:24:39,750 --> 00:24:37,600
all the different elements and so we can

768
00:24:41,190 --> 00:24:39,760
take a point map of all these different

769
00:24:43,269 --> 00:24:41,200
elements which gives us

770
00:24:44,390 --> 00:24:43,279
so much information if there are bio

771
00:24:46,390 --> 00:24:44,400
signatures there

772
00:24:48,390 --> 00:24:46,400
so i'm going to be really excited to see

773
00:24:49,510 --> 00:24:48,400
the pretty pretty element maps that

774
00:24:50,070 --> 00:24:49,520
we're going to get back from pixel

775
00:24:51,750 --> 00:24:50,080
because that

776
00:24:53,990 --> 00:24:51,760
can give us so much information about

777
00:24:56,310 --> 00:24:54,000
what bio signatures can be there

778
00:24:57,590 --> 00:24:56,320
i'm so excited too i love element maps

779
00:24:59,909 --> 00:24:57,600
they're so beautiful

780
00:25:01,350 --> 00:24:59,919
uh how about zvet what's your favorite

781
00:25:04,149 --> 00:25:01,360
instrument and maybe like one simple

782
00:25:08,789 --> 00:25:05,909
i'm gonna have to agree with the poll

783
00:25:11,110 --> 00:25:08,799
results definitely sherlock all the way

784
00:25:12,710 --> 00:25:11,120
this is a um an instrument where you get

785
00:25:14,870 --> 00:25:12,720
kind of a two for one you not only get

786
00:25:16,950 --> 00:25:14,880
the ramen spectral fingerprint but you

787
00:25:18,149 --> 00:25:16,960
also get a fluorescence fingerprint

788
00:25:20,950 --> 00:25:18,159

which gives you a different

789
00:25:21,669 --> 00:25:20,960
level of fingerprinting of the same

790
00:25:23,269 --> 00:25:21,679
structure

791
00:25:25,350 --> 00:25:23,279
so you get a two for one spectral

792
00:25:28,070 --> 00:25:25,360
structure about organics

793
00:25:29,110 --> 00:25:28,080
in a sample and sherlock is said to be

794
00:25:31,510 --> 00:25:29,120
as sensitive as

795
00:25:33,110 --> 00:25:31,520
parts per million so that is pretty

796
00:25:34,630 --> 00:25:33,120
pretty amazing resolution that we're

797
00:25:35,510 --> 00:25:34,640
going to get on tiny microscopic

798
00:25:38,149 --> 00:25:35,520
structures

799
00:25:39,269 --> 00:25:38,159
and if we couple the sherlock maps with

800
00:25:41,510 --> 00:25:39,279
pixel maps

801
00:25:43,430 --> 00:25:41,520
that i would say is actually going to be

802
00:25:45,190 --> 00:25:43,440
way cooler

803
00:25:47,110 --> 00:25:45,200
awesome so you guys heard it uh so we

804
00:25:47,750 --> 00:25:47,120
have super cam pixel and sherlock are

805
00:25:49,230 --> 00:25:47,760
kind of

806
00:25:50,789 --> 00:25:49,240
at the top of our list here as

807
00:25:52,950 --> 00:25:50,799
astrobiologists

808
00:25:53,990 --> 00:25:52,960
um even though i'm also really excited

809
00:25:55,750 --> 00:25:54,000
for ingenuity

810
00:25:57,510 --> 00:25:55,760
it's going to be a very simple test of a

811
00:25:58,950 --> 00:25:57,520
drone but it will be the first drone

812
00:26:00,470 --> 00:25:58,960
we're going to try to launch off of a

813
00:26:01,669 --> 00:26:00,480

rover on mars so that should be very

814
00:26:03,750 --> 00:26:01,679
cool as well

815
00:26:05,190 --> 00:26:03,760
uh so before i go on any further i do

816
00:26:06,870 --> 00:26:05,200
want to remind our audience watching you

817
00:26:08,870 --> 00:26:06,880
can still ask questions for

818
00:26:10,230 --> 00:26:08,880
our panelists in the chats on

819
00:26:12,630 --> 00:26:10,240
sagittnet.org or

820
00:26:14,390 --> 00:26:12,640
in the nasa astrobiology facebook chat

821
00:26:17,350 --> 00:26:14,400
uh or on twitter using

822
00:26:18,630 --> 00:26:17,360
ask astrobio uh i promise i will open it

823
00:26:20,230 --> 00:26:18,640
up to your questions soon and i'll try

824
00:26:22,390 --> 00:26:20,240
to get to as many as we can

825
00:26:24,070 --> 00:26:22,400
but first i have uh one more question

826
00:26:26,070 --> 00:26:24,080
for each of you directly

827
00:26:28,870 --> 00:26:26,080
uh francis you know a lot of your work

828
00:26:30,789 --> 00:26:28,880
is focused on paleo environments

829
00:26:32,549 --> 00:26:30,799
and past surface environments here on

830
00:26:34,470 --> 00:26:32,559
earth and in planetary science for other

831
00:26:36,950 --> 00:26:34,480
worlds like mars

832
00:26:39,350 --> 00:26:36,960
so what are the current big issues in

833
00:26:42,630 --> 00:26:39,360
understanding the past history of mars

834
00:26:44,789 --> 00:26:42,640
and how will missions like hope and tn1

835
00:26:46,789 --> 00:26:44,799
and especially perseverance how will

836
00:26:48,390 --> 00:26:46,799
they help us learn more and uncover some

837
00:26:50,470 --> 00:26:48,400
of these mysteries about mars past

838
00:26:53,190 --> 00:26:50,480

history

839
00:26:54,310 --> 00:26:53,200
yeah so um so in addition to this big

840
00:26:55,909 --> 00:26:54,320
question that we're trying to answer

841
00:26:58,149 --> 00:26:55,919
with perseverance right which is

842
00:26:59,190 --> 00:26:58,159
was our actual microbial life on mars in

843
00:27:01,590 --> 00:26:59,200
the past

844
00:27:02,230 --> 00:27:01,600
uh the two main questions that we really

845
00:27:04,710 --> 00:27:02,240
have about

846
00:27:05,669 --> 00:27:04,720
mars concerns its climate and its water

847
00:27:07,990 --> 00:27:05,679
history

848
00:27:08,789 --> 00:27:08,000
and the reason that we're asking these

849
00:27:11,350 --> 00:27:08,799
questions

850
00:27:11,990 --> 00:27:11,360
is because mars today is cold and dry

851
00:27:14,710 --> 00:27:12,000
with a

852
00:27:16,630 --> 00:27:14,720
really thin atmosphere and uh liquid

853
00:27:17,909 --> 00:27:16,640
water is not geologically stable on the

854
00:27:19,909 --> 00:27:17,919
surface of mars today

855
00:27:21,909 --> 00:27:19,919
however as we've been talking about

856
00:27:23,350 --> 00:27:21,919
there's uh abundant evidence for the

857
00:27:25,990 --> 00:27:23,360
presence of liquid water

858
00:27:27,430 --> 00:27:26,000
on the surface of of mars in the past

859
00:27:29,350 --> 00:27:27,440
and so this suggests to us

860
00:27:30,710 --> 00:27:29,360
that the climate of mars must have been

861
00:27:32,789 --> 00:27:30,720
different in the past

862
00:27:34,710 --> 00:27:32,799
uh than today to be able to sustain

863
00:27:37,990 --> 00:27:34,720

those water environments

864
00:27:38,630 --> 00:27:38,000
and so uh we really want to truly

865
00:27:41,269 --> 00:27:38,640
understand

866
00:27:42,630 --> 00:27:41,279
um what was the climate of mars how has

867
00:27:44,149 --> 00:27:42,640
it changed through time

868
00:27:46,310 --> 00:27:44,159
and then also with that the water

869
00:27:47,909 --> 00:27:46,320
history so how much liquid water was

870
00:27:48,710 --> 00:27:47,919
present on the surface of mars in the

871
00:27:50,950 --> 00:27:48,720
past

872
00:27:51,909 --> 00:27:50,960
um how how was it distributed on the

873
00:27:54,870 --> 00:27:51,919
surface

874
00:27:56,870 --> 00:27:54,880
and then uh when during mars's history

875
00:27:58,870 --> 00:27:56,880
did we have these water events

876
00:28:00,630 --> 00:27:58,880
and so uh with the new missions well

877
00:28:02,549 --> 00:28:00,640
with curiosity we're currently exploring

878
00:28:03,029 --> 00:28:02,559
some of these questions but with the new

879
00:28:06,549 --> 00:28:03,039
mission

880
00:28:10,149 --> 00:28:06,559
perseverance

881
00:28:11,830 --> 00:28:10,159
and then also the 101 one missions and

882
00:28:14,470 --> 00:28:11,840
both of those of course are rovers

883
00:28:15,909 --> 00:28:14,480
and so we'll be able to characterize the

884
00:28:17,430 --> 00:28:15,919
physical characteristics and the

885
00:28:19,190 --> 00:28:17,440
chemical characteristics

886
00:28:21,190 --> 00:28:19,200
of the surface of mars to try to

887
00:28:22,630 --> 00:28:21,200
interpret uh these paleo environments

888
00:28:23,510 --> 00:28:22,640

from the rock records so these past

889
00:28:25,909 --> 00:28:23,520
environments

890
00:28:28,149 --> 00:28:25,919
and that will give us information about

891
00:28:30,870 --> 00:28:28,159
what mars was like in the past

892
00:28:31,990 --> 00:28:30,880
and then uh with uh chin one uh one it

893
00:28:34,310 --> 00:28:32,000
also has an orbiter

894
00:28:37,269 --> 00:28:34,320
and so uh with that it'll be able to uh

895
00:28:39,430 --> 00:28:37,279
take color images of the surface of mars

896
00:28:41,110 --> 00:28:39,440
and um and so hopefully it'll give a

897
00:28:44,070 --> 00:28:41,120
more regional perspective

898
00:28:44,549 --> 00:28:44,080
of of the geology of mars and then tie

899
00:28:47,909 --> 00:28:44,559
with

900
00:28:49,909 --> 00:28:47,919
hope mission

901
00:28:51,909 --> 00:28:49,919
um that's uh specifically gonna be

902
00:28:53,269 --> 00:28:51,919
looking at uh characterizing the

903
00:28:55,029 --> 00:28:53,279
atmosphere of mars

904
00:28:56,950 --> 00:28:55,039
uh specifically the upper atmosphere and

905
00:28:59,110 --> 00:28:56,960
trying to constrain how much hydrogen

906
00:29:01,669 --> 00:28:59,120
and oxygen is being lost currently

907
00:29:02,470 --> 00:29:01,679
uh on mars and then also trying to

908
00:29:04,389 --> 00:29:02,480
understand

909
00:29:05,909 --> 00:29:04,399
how different parts of mars's atmosphere

910
00:29:07,750 --> 00:29:05,919
uh interacts with each other

911
00:29:09,590 --> 00:29:07,760
and so with that we might get a better

912
00:29:12,389 --> 00:29:09,600
understanding of not only what

913
00:29:14,070 --> 00:29:12,399

martin's atmosphere is today but also uh

914
00:29:16,070 --> 00:29:14,080
how it was like in the past

915
00:29:18,230 --> 00:29:16,080
and so uh with all of these missions as

916
00:29:19,269 --> 00:29:18,240
i i've just said these are all different

917
00:29:21,269 --> 00:29:19,279
and they're all going to have different

918
00:29:23,909 --> 00:29:21,279
instruments but they're all going to be

919
00:29:24,870 --> 00:29:23,919
uh working together to try to answer

920
00:29:26,950 --> 00:29:24,880
some of these big

921
00:29:29,430 --> 00:29:26,960
questions that we have about uh marx's

922
00:29:30,950 --> 00:29:29,440
climate and uh its water uh history and

923
00:29:32,310 --> 00:29:30,960
how it's changed uh

924
00:29:34,070 --> 00:29:32,320
through time and so i'm really excited

925
00:29:36,789 --> 00:29:34,080
it's a good time to be a martian

926
00:29:38,230 --> 00:29:36,799
um and have all these missions uh uh

927
00:29:40,070 --> 00:29:38,240
working at the same time

928
00:29:41,590 --> 00:29:40,080
yeah that is very cool yeah uh it's just

929
00:29:42,789 --> 00:29:41,600
so cool to think about you know like the

930
00:29:44,630 --> 00:29:42,799
synergy like you mentioned

931
00:29:46,710 --> 00:29:44,640
of these different robot explorers who

932
00:29:47,590 --> 00:29:46,720
are doing all this science you know with

933
00:29:51,029 --> 00:29:47,600
us and for us

934
00:29:52,870 --> 00:29:51,039
at mars um so and this is something

935
00:29:54,710 --> 00:29:52,880
that's really near and dear to my heart

936
00:29:56,470 --> 00:29:54,720
uh are analog systems and we've

937
00:29:58,230 --> 00:29:56,480
mentioned this a couple times already

938
00:30:00,230 --> 00:29:58,240

uh earlier you mentioned the great salt

939
00:30:01,990 --> 00:30:00,240
lake and your field site near there

940
00:30:04,549 --> 00:30:02,000
you've also recently been featured in

941
00:30:05,909 --> 00:30:04,559
the netflix documentary alien worlds

942
00:30:08,549 --> 00:30:05,919
doing some work in the danakil

943
00:30:09,750 --> 00:30:08,559
depression in ethiopia i wonder if you

944
00:30:12,630 --> 00:30:09,760
can tell our audience

945
00:30:13,029 --> 00:30:12,640
about these analog sites and why we use

946
00:30:14,630 --> 00:30:13,039
them

947
00:30:15,990 --> 00:30:14,640
as test beds for mars and what we're

948
00:30:17,830 --> 00:30:16,000
learning from all these extreme

949
00:30:20,789 --> 00:30:17,840
environments on earth

950
00:30:22,070 --> 00:30:20,799
um certainly so um yeah so my field set

951
00:30:23,430 --> 00:30:22,080
my other field site in utah

952
00:30:25,669 --> 00:30:23,440
is the great salt lake desert which is

953
00:30:27,669 --> 00:30:25,679
the paleo lake basin like jezreel crater

954
00:30:29,990 --> 00:30:27,679
um and then the identical depression is

955
00:30:31,510 --> 00:30:30,000
a as another amazing area where we have

956
00:30:33,029 --> 00:30:31,520
things like we have um

957
00:30:34,630 --> 00:30:33,039
we have playo lake basins and we have

958
00:30:35,990 --> 00:30:34,640
playas and we also have this great

959
00:30:38,310 --> 00:30:36,000
amazing hydrothermal system

960
00:30:39,269 --> 00:30:38,320
the dollop hydrothermal system that is

961
00:30:42,389 --> 00:30:39,279
unique because

962
00:30:42,789 --> 00:30:42,399
it is a poly extreme environment it is

963
00:30:45,669 --> 00:30:42,799

um

964
00:30:47,750 --> 00:30:45,679
super hot it's super acidic ph is two or

965
00:30:50,549 --> 00:30:47,760
below i've measured down to one

966
00:30:52,230 --> 00:30:50,559
and also extremely salty like all the

967
00:30:54,070 --> 00:30:52,240
terraced features that you see

968
00:30:56,630 --> 00:30:54,080
you saw in that netflix episode those

969
00:30:58,549 --> 00:30:56,640
were all salt but then also lots of iron

970
00:30:59,669 --> 00:30:58,559
and lots of sulfur because there's a lot

971
00:31:01,029 --> 00:30:59,679
of salt the salt

972
00:31:02,870 --> 00:31:01,039
in the subsurface gets mixed with the

973
00:31:03,669 --> 00:31:02,880
iron and sulfur and gets brought to the

974
00:31:05,590 --> 00:31:03,679
surface so

975
00:31:07,190 --> 00:31:05,600
the reason we like to use these analog

976
00:31:08,710 --> 00:31:07,200
environments is because

977
00:31:10,470 --> 00:31:08,720
they're they're they're analogous to

978
00:31:11,830 --> 00:31:10,480
mars in kind of their makeup and their

979
00:31:14,389 --> 00:31:11,840
geological makeup the same

980
00:31:14,950 --> 00:31:14,399
similar minerals kind of similar

981
00:31:16,389 --> 00:31:14,960
minerals

982
00:31:18,230 --> 00:31:16,399
and and similar environments that we

983
00:31:19,990 --> 00:31:18,240
think we that we had on mars

984
00:31:21,350 --> 00:31:20,000
but on earth we don't even understand

985
00:31:22,950 --> 00:31:21,360
them ourselves so

986
00:31:24,230 --> 00:31:22,960
we try to understand these environments

987
00:31:24,870 --> 00:31:24,240
and try to understand the microbes that

988
00:31:26,389 --> 00:31:24,880

live in them

989
00:31:28,389 --> 00:31:26,399
and once we can start to understand them

990
00:31:29,350 --> 00:31:28,399
then we can try to use that information

991
00:31:30,870 --> 00:31:29,360
to translate

992
00:31:33,110 --> 00:31:30,880
how we can look for that kind of

993
00:31:36,230 --> 00:31:33,120
environment on mars like for example

994
00:31:38,789 --> 00:31:36,240
um at uh dalal the thought

995
00:31:40,470 --> 00:31:38,799
of a poly extreme salt hydrothermal

996
00:31:42,710 --> 00:31:40,480
system on mars

997
00:31:44,470 --> 00:31:42,720
never came to my mind until i went to

998
00:31:47,750 --> 00:31:44,480
dalal and was like

999
00:31:49,750 --> 00:31:47,760
this could exist on mars oh my gosh

1000
00:31:51,509 --> 00:31:49,760
so how do we go about looking for that

1001
00:31:54,389 --> 00:31:51,519
so how do we go about looking for

1002
00:31:54,870 --> 00:31:54,399
remnants of a super acidic super salty

1003
00:31:56,710 --> 00:31:54,880
iron

1004
00:31:58,470 --> 00:31:56,720
for salt hydrothermal system well we

1005
00:31:59,110 --> 00:31:58,480
need to characterize the system on earth

1006
00:32:00,870 --> 00:31:59,120
so we know

1007
00:32:02,389 --> 00:32:00,880
what kind of minerals are there what are

1008
00:32:03,830 --> 00:32:02,399
their mineral mixes look like

1009
00:32:05,350 --> 00:32:03,840
what do they look like to mars like

1010
00:32:07,029 --> 00:32:05,360
instruments what would they look like

1011
00:32:08,789 --> 00:32:07,039
you know if we sent a rover there

1012
00:32:10,230 --> 00:32:08,799
and then then the question is if it's a

1013
00:32:12,789 --> 00:32:10,240

habitable environment which

1014
00:32:14,389 --> 00:32:12,799
we're exploring um dalo and we've got

1015
00:32:15,830 --> 00:32:14,399
different evidence that you know we're

1016
00:32:17,590 --> 00:32:15,840
there's kind of a big debate about the

1017
00:32:18,950 --> 00:32:17,600
evidence of the life there we've got

1018
00:32:20,389 --> 00:32:18,960
those of us that have found life and

1019
00:32:20,710 --> 00:32:20,399
then there's those that haven't found it

1020
00:32:21,990 --> 00:32:20,720
so

1021
00:32:24,389 --> 00:32:22,000
you know we're being scientists and

1022
00:32:25,990 --> 00:32:24,399
arguing about that um but we're trying

1023
00:32:27,029 --> 00:32:26,000
to understand if life can live there how

1024
00:32:28,630 --> 00:32:27,039
can it live there

1025
00:32:30,149 --> 00:32:28,640
and what kind of bio signatures would it

1026
00:32:33,590 --> 00:32:30,159
leave so that's why these environments

1027
00:32:34,149 --> 00:32:33,600
are so important because we have a data

1028
00:32:36,389 --> 00:32:34,159
set of

1029
00:32:37,350 --> 00:32:36,399
one to compare against when we go to

1030
00:32:40,310 --> 00:32:37,360
look for

1031
00:32:42,149 --> 00:32:40,320
life on another planet so it is the the

1032
00:32:44,149 --> 00:32:42,159
veritable needle in a haystack

1033
00:32:45,590 --> 00:32:44,159
what we just try to do with looking at

1034
00:32:46,950 --> 00:32:45,600
life on earth and trying to understand

1035
00:32:48,389 --> 00:32:46,960
similar environments is we try to

1036
00:32:48,870 --> 00:32:48,399
organize the haystack a little bit

1037
00:32:50,310 --> 00:32:48,880
better

1038
00:32:53,029 --> 00:32:50,320

so we can find the needle a little

1039
00:32:53,430 --> 00:32:53,039
easier but it's still a very big problem

1040
00:32:56,710 --> 00:32:53,440
so

1041
00:32:58,630 --> 00:32:56,720
but analog environments help us at least

1042
00:33:00,470 --> 00:32:58,640
give us a kind of a little bit of a

1043
00:33:01,509 --> 00:33:00,480
direction in with which to go in to try

1044
00:33:03,909 --> 00:33:01,519
to find

1045
00:33:05,909 --> 00:33:03,919
evidence for life on another planet so

1046
00:33:08,950 --> 00:33:05,919
it's really important and really helpful

1047
00:33:09,990 --> 00:33:08,960
and it helps us understand how life came

1048
00:33:12,149 --> 00:33:10,000
to be here on earth and

1049
00:33:13,830 --> 00:33:12,159
how diverse life is on earth because we

1050
00:33:14,149 --> 00:33:13,840
still we still don't fully understand

1051
00:33:18,870 --> 00:33:14,159
how

1052
00:33:19,590 --> 00:33:18,880
so pervasive on earth so it's a really

1053
00:33:21,669 --> 00:33:19,600
great

1054
00:33:23,509 --> 00:33:21,679
opportunity to both learn about our own

1055
00:33:26,630 --> 00:33:23,519
planet and our origins

1056
00:33:29,110 --> 00:33:26,640
and help us um develop better tools to

1057
00:33:31,269 --> 00:33:29,120
look for life on other planets

1058
00:33:32,549 --> 00:33:31,279
yeah so a few things that you pointed

1059
00:33:32,950 --> 00:33:32,559
out there that i really appreciate one

1060
00:33:36,470 --> 00:33:32,960
there's

1061
00:33:38,070 --> 00:33:36,480
sciences i love that you point out that

1062
00:33:39,430 --> 00:33:38,080
is there life is there not life you know

1063
00:33:41,029 --> 00:33:39,440

and there's an active debate there just

1064
00:33:42,630 --> 00:33:41,039
like right now with the phosphine

1065
00:33:44,789 --> 00:33:42,640
potential detection on venus there's

1066
00:33:46,789 --> 00:33:44,799
been active debate in the literature

1067
00:33:48,310 --> 00:33:46,799
uh from scientists on both sides trying

1068
00:33:49,830 --> 00:33:48,320
to figure out if that was a real

1069
00:33:51,590 --> 00:33:49,840
detection or not and

1070
00:33:53,430 --> 00:33:51,600
if it is what does it mean and this

1071
00:33:56,070 --> 00:33:53,440
happens a lot in the sciences

1072
00:33:57,029 --> 00:33:56,080
in various ways uh and i'm really glad

1073
00:33:57,830 --> 00:33:57,039
too that you brought up you know the

1074
00:33:59,190 --> 00:33:57,840
importance of

1075
00:34:01,190 --> 00:33:59,200
understanding life on earth we don't

1076
00:34:02,630 --> 00:34:01,200
have everything solved uh

1077
00:34:04,470 --> 00:34:02,640
and so a lot of times for us

1078
00:34:06,710 --> 00:34:04,480
astrobiologists people right away want

1079
00:34:09,190 --> 00:34:06,720
to talk about aliens and other worlds

1080
00:34:10,310 --> 00:34:09,200
and we almost almost instantly kind of

1081
00:34:11,430 --> 00:34:10,320
just skim past

1082
00:34:13,669 --> 00:34:11,440
the thing that we really don't

1083
00:34:15,430 --> 00:34:13,679
understand is is life here on earth

1084
00:34:16,389 --> 00:34:15,440
where did it come from how did we start

1085
00:34:17,669 --> 00:34:16,399
here on earth and

1086
00:34:19,589 --> 00:34:17,679
how have we evolved through time we've

1087
00:34:22,310 --> 00:34:19,599
learned so much but there's still

1088
00:34:23,909 --> 00:34:22,320

a lot more to learn uh zvet i see you

1089
00:34:24,790 --> 00:34:23,919
joining us again i'm glad you have to

1090
00:34:26,470 --> 00:34:24,800
reconnect

1091
00:34:28,069 --> 00:34:26,480
uh i do have a question for you

1092
00:34:29,909 --> 00:34:28,079
involving spectroscopy

1093
00:34:32,069 --> 00:34:29,919
you mentioned earlier that that you know

1094
00:34:32,950 --> 00:34:32,079
sherlock is not just raman but it's also

1095
00:34:34,389 --> 00:34:32,960
fluorescent

1096
00:34:36,550 --> 00:34:34,399
and you've got a bunch of work in the

1097
00:34:38,710 --> 00:34:36,560
realm of spectroscopy

1098
00:34:39,750 --> 00:34:38,720
that's relevant to percy i'm wondering

1099
00:34:42,149 --> 00:34:39,760
if you can talk a bit

1100
00:34:44,069 --> 00:34:42,159
uh for our very general audience about

1101
00:34:46,829 --> 00:34:44,079
what spectroscopy is

1102
00:34:48,310 --> 00:34:46,839
and why this is so important for mars

1103
00:34:51,430 --> 00:34:48,320
astrobiology

1104
00:34:52,790 --> 00:34:51,440
yeah um so a lot of

1105
00:34:54,710 --> 00:34:52,800
people are familiar with raman

1106
00:34:56,710 --> 00:34:54,720
spectroscopy this is basically a way to

1107
00:34:57,829 --> 00:34:56,720
fingerprint a molecular or a mineral

1108
00:34:59,829 --> 00:34:57,839
structure you're basically

1109
00:35:00,950 --> 00:34:59,839
bouncing laser light off the surface of

1110
00:35:03,109 --> 00:35:00,960
your

1111
00:35:05,030 --> 00:35:03,119
sample and that is telling you something

1112
00:35:06,950 --> 00:35:05,040
about the vibrational structure of that

1113
00:35:09,349 --> 00:35:06,960

sample the way that light

1114
00:35:10,069 --> 00:35:09,359
interacts with that sampling bounces

1115
00:35:12,630 --> 00:35:10,079
back off

1116
00:35:13,109 --> 00:35:12,640
and fluorescent spectroscopy is kind of

1117
00:35:16,630 --> 00:35:13,119
its

1118
00:35:17,589 --> 00:35:16,640
lesser-known cousin but um i would say a

1119
00:35:20,870 --> 00:35:17,599
very powerful

1120
00:35:24,310 --> 00:35:20,880
um complementary technique to ramen um

1121
00:35:27,270 --> 00:35:24,320
fluorescence gives you an absorption

1122
00:35:28,790 --> 00:35:27,280
and every emission of that energy so

1123
00:35:30,870 --> 00:35:28,800
you're getting you're probing a slightly

1124
00:35:32,230 --> 00:35:30,880
different part of that same structure

1125
00:35:34,630 --> 00:35:32,240
and you're getting two different types

1126
00:35:36,470 --> 00:35:34,640
of spectral fingerprints with one

1127
00:35:38,150 --> 00:35:36,480
spectrometer basically that's why i

1128
00:35:41,109 --> 00:35:38,160
called it a two for one

1129
00:35:42,310 --> 00:35:41,119
and the really interesting thing about

1130
00:35:44,630 --> 00:35:42,320
sherlock

1131
00:35:46,150 --> 00:35:44,640
as well as super cam on the perseverance

1132
00:35:47,990 --> 00:35:46,160
rover is that um

1133
00:35:49,270 --> 00:35:48,000
they're both combined ramen and

1134
00:35:51,829 --> 00:35:49,280
fluorescent systems

1135
00:35:53,430 --> 00:35:51,839
and they're both this is the first time

1136
00:35:58,069 --> 00:35:53,440
we've ever put

1137
00:36:00,710 --> 00:35:58,079
a laser ramen and a laser fluorescent

1138
00:36:01,829 --> 00:36:00,720

system on the surface we're about to put

1139
00:36:02,790 --> 00:36:01,839
this on the surface of another planet

1140
00:36:04,069 --> 00:36:02,800
for the first time this is the first

1141
00:36:05,910 --> 00:36:04,079
time they're flying ever

1142
00:36:08,550 --> 00:36:05,920
and on perseverance rover we're getting

1143
00:36:11,109 --> 00:36:08,560
not one but two of those systems

1144
00:36:13,589 --> 00:36:11,119
on the same rover um and the differences

1145
00:36:15,510 --> 00:36:13,599
are there are a lot of differences

1146
00:36:17,750 --> 00:36:15,520
between the the two instruments of

1147
00:36:18,870 --> 00:36:17,760
course um supercam is more of a distance

1148
00:36:19,750 --> 00:36:18,880
technique we're going to be able to

1149
00:36:21,990 --> 00:36:19,760
scout out

1150
00:36:23,670 --> 00:36:22,000
um rock sort of in the distance and and

1151
00:36:26,230 --> 00:36:23,680
say yeah that that's the one that i want

1152
00:36:29,910 --> 00:36:26,240
to do more close-up analyses on and

1153
00:36:32,230 --> 00:36:29,920
sure is really gonna be a

1154
00:36:33,109 --> 00:36:32,240
contact uh instrument where you're gonna

1155
00:36:35,750 --> 00:36:33,119
be able to get you know

1156
00:36:37,910 --> 00:36:35,760
millimeter or even micro scales that are

1157
00:36:39,589 --> 00:36:37,920
like the width of a human hair basically

1158
00:36:41,670 --> 00:36:39,599
so you're really gonna be able to see a

1159
00:36:42,550 --> 00:36:41,680
lot higher resolution with the sherlock

1160
00:36:45,190 --> 00:36:42,560
instrument

1161
00:36:47,109 --> 00:36:45,200
and um so i'm excited because because

1162
00:36:49,109 --> 00:36:47,119
i've worked with these instruments

1163
00:36:50,230 --> 00:36:49,119

um since graduate school and this is

1164
00:36:53,270 --> 00:36:50,240
finally we're going to see them

1165
00:36:55,349 --> 00:36:53,280
in flight in use in action um and

1166
00:36:58,310 --> 00:36:55,359
and also i think that they're very very

1167
00:37:01,430 --> 00:36:58,320
powerful instruments to be able to

1168
00:37:04,390 --> 00:37:01,440
probe a sample non-destructively um

1169
00:37:06,150 --> 00:37:04,400
we we've sent organic instruments to for

1170
00:37:07,109 --> 00:37:06,160
example on curiosity rover we've got the

1171
00:37:09,109 --> 00:37:07,119
sam instrument

1172
00:37:10,470 --> 00:37:09,119
and that is a very powerful wet

1173
00:37:12,230 --> 00:37:10,480
chemistry lab

1174
00:37:14,710 --> 00:37:12,240
um but the advantage of raman

1175
00:37:16,550 --> 00:37:14,720
spectroscopy is we don't have to powder

1176
00:37:17,790 --> 00:37:16,560
those samples we don't have to destroy

1177
00:37:20,550 --> 00:37:17,800
that

1178
00:37:23,349 --> 00:37:20,560
surrounding uh context

1179
00:37:25,270 --> 00:37:23,359
which we in astrobiology really really

1180
00:37:27,109 --> 00:37:25,280
we we love our context we want to know

1181
00:37:28,710 --> 00:37:27,119
what is surrounding that organic

1182
00:37:29,910 --> 00:37:28,720
structure or that potential bio

1183
00:37:32,630 --> 00:37:29,920
signature

1184
00:37:33,430 --> 00:37:32,640
without degrading the rest of that rock

1185
00:37:36,230 --> 00:37:33,440
matrix

1186
00:37:37,910 --> 00:37:36,240
and so spectral laser spectroscopy

1187
00:37:39,510 --> 00:37:37,920
represents one very powerful

1188
00:37:41,670 --> 00:37:39,520

and high resolution technique to get

1189
00:37:44,390 --> 00:37:41,680
this type of data and um on the

1190
00:37:47,190 --> 00:37:44,400
perseverance rover the strategy sort of

1191
00:37:47,750 --> 00:37:47,200
to to use spectroscopy as kind of a

1192
00:37:51,750 --> 00:37:47,760
first

1193
00:37:54,310 --> 00:37:51,760
step to find potential bio signatures

1194
00:37:55,190 --> 00:37:54,320
and then continue to characterize those

1195
00:37:57,109 --> 00:37:55,200
those targets

1196
00:37:58,870 --> 00:37:57,119
with the rest of the very powerful

1197
00:38:01,349 --> 00:37:58,880
instrumentation with the pixel

1198
00:38:02,230 --> 00:38:01,359
you know with the other with the imagers

1199
00:38:07,109 --> 00:38:02,240
and

1200
00:38:09,910 --> 00:38:07,119
they come back to earth

1201
00:38:10,630 --> 00:38:09,920
we'll sort of have an end to end um

1202
00:38:12,310 --> 00:38:10,640
analysis

1203
00:38:14,630 --> 00:38:12,320
on those samples where we start with a

1204
00:38:15,349 --> 00:38:14,640
non-destructive non-abrasive technique

1205
00:38:18,470 --> 00:38:15,359
like ramen

1206
00:38:20,230 --> 00:38:18,480
we target exactly where in that raw core

1207
00:38:21,829 --> 00:38:20,240
we want to look for a biosignature you

1208
00:38:22,550 --> 00:38:21,839
know this region with this preserved

1209
00:38:25,349 --> 00:38:22,560
little

1210
00:38:26,710 --> 00:38:25,359
potentially organic structure and then

1211
00:38:29,109 --> 00:38:26,720
back on earth we can

1212
00:38:30,390 --> 00:38:29,119
relocate that same structure and then

1213
00:38:33,589 --> 00:38:30,400

continue to do

1214
00:38:35,510 --> 00:38:33,599
more destructive analyses and more

1215
00:38:36,790 --> 00:38:35,520
higher resolution analyses

1216
00:38:38,550 --> 00:38:36,800
uh like graham mentioned you know

1217
00:38:42,230 --> 00:38:38,560
synchrotron and additional

1218
00:38:42,550 --> 00:38:42,240
um types of uh analyses back on earth so

1219
00:38:46,470 --> 00:38:42,560
i

1220
00:38:49,510 --> 00:38:46,480
represents a very powerful

1221
00:38:52,630 --> 00:38:49,520
first step in this end-to-end way

1222
00:38:54,150 --> 00:38:52,640
of looking for bio signatures and this

1223
00:38:56,950 --> 00:38:54,160
is the way

1224
00:38:58,790 --> 00:38:56,960
we would do it on earth if we were

1225
00:39:00,390 --> 00:38:58,800
looking for

1226
00:39:02,069 --> 00:39:00,400
bio biosignatures on earth we probably

1227
00:39:05,510 --> 00:39:02,079
start with something like

1228
00:39:07,670 --> 00:39:05,520
a a non-destructive spectroscopy type

1229
00:39:09,030 --> 00:39:07,680
uh analysis fingerprint the regions

1230
00:39:11,510 --> 00:39:09,040
we're looking for and then

1231
00:39:13,349 --> 00:39:11,520
build on the level of a higher

1232
00:39:16,470 --> 00:39:13,359
resolution and

1233
00:39:18,390 --> 00:39:16,480
additional layers of data as we

1234
00:39:19,990 --> 00:39:18,400
progress through our analysis i love

1235
00:39:21,349 --> 00:39:20,000
that and like as you were speaking two

1236
00:39:22,790 --> 00:39:21,359
things that came to mind for me were

1237
00:39:24,550 --> 00:39:22,800
scale and context

1238
00:39:25,990 --> 00:39:24,560

uh being a geologist but also a

1239
00:39:27,109 --> 00:39:26,000
biologist and having a background in

1240
00:39:28,630 --> 00:39:27,119
astrophysics i

1241
00:39:30,150 --> 00:39:28,640
scale is a huge thing you know we have

1242
00:39:31,270 --> 00:39:30,160
different scales of remote sensing in

1243
00:39:32,630 --> 00:39:31,280
these instruments and

1244
00:39:34,069 --> 00:39:32,640
different levels at which we they can

1245
00:39:35,589 --> 00:39:34,079
probe into the sample and bringing

1246
00:39:36,390 --> 00:39:35,599
samples back and getting even finer

1247
00:39:37,990 --> 00:39:36,400
scale

1248
00:39:40,390 --> 00:39:38,000
measurements but then also understanding

1249
00:39:42,390 --> 00:39:40,400
the context the history

1250
00:39:43,829 --> 00:39:42,400
the things going on geologically around

1251
00:39:45,349 --> 00:39:43,839
it what is the environment these are all

1252
00:39:47,270 --> 00:39:45,359
so important for us

1253
00:39:48,630 --> 00:39:47,280
uh i could honestly nerd out with all

1254
00:39:50,710 --> 00:39:48,640
three of you for like ever

1255
00:39:51,910 --> 00:39:50,720
just talking about the astrobiology of

1256
00:39:54,150 --> 00:39:51,920
mars and beyond

1257
00:39:56,069 --> 00:39:54,160
um but uh we are running out of time a

1258
00:39:58,069 --> 00:39:56,079
little bit here and so i really want to

1259
00:39:59,349 --> 00:39:58,079
open it up to the audience questions i

1260
00:39:59,750 --> 00:39:59,359
have been informed we're actually

1261
00:40:02,230 --> 00:39:59,760
getting

1262
00:40:04,069 --> 00:40:02,240
a lot of questions uh and so if you

1263
00:40:06,470 --> 00:40:04,079

wouldn't mind just being a little brief

1264
00:40:07,829 --> 00:40:06,480
if you can uh when you answer and any of

1265
00:40:10,150 --> 00:40:07,839
you can answer these questions

1266
00:40:12,069 --> 00:40:10,160
i will ask some directly to a few of you

1267
00:40:15,430 --> 00:40:12,079
um the first question we have is from

1268
00:40:17,430 --> 00:40:15,440
romell kinger on twitter romel asks

1269
00:40:19,349 --> 00:40:17,440
how will perseverance help in finding

1270
00:40:21,589 --> 00:40:19,359
the origin of methane

1271
00:40:23,190 --> 00:40:21,599
and its seasonal fluctuations as seen on

1272
00:40:25,109 --> 00:40:23,200
mars by curiosity

1273
00:40:25,550 --> 00:40:25,119
i think the answer is that's a good

1274
00:40:28,150 --> 00:40:25,560
question

1275
00:40:30,630 --> 00:40:28,160
[Laughter]

1276
00:40:31,910 --> 00:40:30,640
that that the origin of methane is a big

1277
00:40:34,470 --> 00:40:31,920
question that

1278
00:40:35,990 --> 00:40:34,480
the whole community is it's one of our

1279
00:40:37,430 --> 00:40:36,000
biggest arguments right now is where is

1280
00:40:41,109 --> 00:40:37,440
that methane coming from

1281
00:40:44,870 --> 00:40:41,119
so um i i i gotta be

1282
00:40:47,910 --> 00:40:44,880
i think that's a good question i i'm not

1283
00:40:48,790 --> 00:40:47,920
a hundred percent sure we can fully

1284
00:40:50,829 --> 00:40:48,800
determine

1285
00:40:51,990 --> 00:40:50,839
the origin of that methane with

1286
00:40:54,150 --> 00:40:52,000
curiosity

1287
00:40:55,589 --> 00:40:54,160
i mean sorry it's with perseverance um i

1288
00:40:57,270 --> 00:40:55,599

think we need some other

1289
00:40:59,109 --> 00:40:57,280
we need some other orbital measurements

1290
00:41:01,349 --> 00:40:59,119
and we we probably also need

1291
00:41:02,390 --> 00:41:01,359
a mission to kind of some of our icier

1292
00:41:03,990 --> 00:41:02,400
areas also

1293
00:41:06,390 --> 00:41:04,000
to kind of help us understand kind of

1294
00:41:07,990 --> 00:41:06,400
what's maybe going on with the methane

1295
00:41:09,670 --> 00:41:08,000
so it's a very good question that i'll

1296
00:41:11,190 --> 00:41:09,680
tell you right now that that the science

1297
00:41:15,109 --> 00:41:11,200
community is definitely still kind of

1298
00:41:18,230 --> 00:41:16,550
yeah and the things that the trace gas

1299
00:41:19,990 --> 00:41:18,240
orbiter and other orbiting

1300
00:41:21,829 --> 00:41:20,000
instruments can help us look for methane

1301
00:41:23,109 --> 00:41:21,839
and and perhaps its sources on mars but

1302
00:41:23,829 --> 00:41:23,119
there's a lot to learn there so thank

1303
00:41:25,750 --> 00:41:23,839
you

1304
00:41:27,270 --> 00:41:25,760
um so we talked a bit about analog

1305
00:41:28,470 --> 00:41:27,280
environments uh kendama mentioned a few

1306
00:41:32,069 --> 00:41:28,480
that she studied

1307
00:41:33,910 --> 00:41:32,079
uh francis carl r lang on segon net

1308
00:41:37,430 --> 00:41:33,920
wanted to know which analog environments

1309
00:41:41,109 --> 00:41:39,990
yeah so uh one of the main environments

1310
00:41:44,230 --> 00:41:41,119
that i'm really interested in

1311
00:41:46,470 --> 00:41:44,240
are uh ice covered lakes and so i for a

1312
00:41:47,990 --> 00:41:46,480
lot of my phd i studied i studied

1313
00:41:49,750 --> 00:41:48,000

lakes that are permanently ice covered

1314
00:41:51,349 --> 00:41:49,760
in antarctica and

1315
00:41:53,109 --> 00:41:51,359
as we've mentioned we found evidence for

1316
00:41:55,270 --> 00:41:53,119
lakes on mars and commonly a lot of

1317
00:41:57,510 --> 00:41:55,280
people assume that because we have lakes

1318
00:41:59,270 --> 00:41:57,520
on mars that uh mars climate must have

1319
00:42:01,829 --> 00:41:59,280
been warm but in antarctica

1320
00:42:02,630 --> 00:42:01,839
we have all these lakes that have uh you

1321
00:42:05,510 --> 00:42:02,640
know some of them

1322
00:42:07,109 --> 00:42:05,520
100 meters of liquid water uh like the

1323
00:42:10,230 --> 00:42:07,119
liquid water columns can be up you know

1324
00:42:11,670 --> 00:42:10,240
up to 100 meters uh deep um and

1325
00:42:13,349 --> 00:42:11,680
the mean annual temperature is below

1326
00:42:15,030 --> 00:42:13,359
zero and so um

1327
00:42:17,190 --> 00:42:15,040
a lot of my work has been focused on

1328
00:42:19,430 --> 00:42:17,200
trying to determine if we can

1329
00:42:20,950 --> 00:42:19,440
identify the difference between paleo

1330
00:42:23,349 --> 00:42:20,960
lakes and the rock record

1331
00:42:24,950 --> 00:42:23,359
um and that's an example i also study

1332
00:42:26,710 --> 00:42:24,960
alluvial fans in the arctic

1333
00:42:28,390 --> 00:42:26,720
which is another type of geologic

1334
00:42:31,030 --> 00:42:28,400
feature that need uh water

1335
00:42:31,510 --> 00:42:31,040
uh to form and they're all over mars and

1336
00:42:32,870 --> 00:42:31,520
so they're

1337
00:42:35,030 --> 00:42:32,880
one of the best evidence that we have

1338
00:42:36,710 --> 00:42:35,040

that uh mars had liquid water

1339
00:42:38,630 --> 00:42:36,720
and so i'm trying to figure out better

1340
00:42:40,550 --> 00:42:38,640
ways to uh

1341
00:42:42,150 --> 00:42:40,560
to determine uh in what environments

1342
00:42:43,829 --> 00:42:42,160
those uh alluvial fans

1343
00:42:45,349 --> 00:42:43,839
uh formed and that's the succinct

1344
00:42:47,030 --> 00:42:45,359
version to keep going

1345
00:42:48,950 --> 00:42:47,040
awesome yeah alluvial fans are so cool

1346
00:42:50,069 --> 00:42:48,960
to see in more barren environments like

1347
00:42:51,430 --> 00:42:50,079
in the arctic where you

1348
00:42:53,829 --> 00:42:51,440
can actually see just like these really

1349
00:42:55,670 --> 00:42:53,839
beautiful features uh our next question

1350
00:42:56,870 --> 00:42:55,680
comes from facebook from user priya

1351
00:42:59,589 --> 00:42:56,880
brata das

1352
00:43:02,309 --> 00:42:59,599
uh priyabrata wants to know so if there

1353
00:43:04,550 --> 00:43:02,319
was an ocean on mars

1354
00:43:09,990 --> 00:43:04,560
can we expect to find any traces of that

1355
00:43:16,150 --> 00:43:13,670
so um i could take a stab at this uh so

1356
00:43:17,910 --> 00:43:16,160
um of course uh as uh kenda mentioned

1357
00:43:20,309 --> 00:43:17,920
there's this uh beautiful

1358
00:43:21,030 --> 00:43:20,319
deltic deposit or they'll take landform

1359
00:43:23,030 --> 00:43:21,040
in

1360
00:43:24,790 --> 00:43:23,040
uh jezreel crater there are actually

1361
00:43:25,990 --> 00:43:24,800
other deltas in jezreel crater that's

1362
00:43:27,430 --> 00:43:26,000
just the most uh

1363
00:43:28,870 --> 00:43:27,440

the bigger the biggest one and the one

1364
00:43:30,150 --> 00:43:28,880
that's going to be targeted with

1365
00:43:32,950 --> 00:43:30,160
perseverance

1366
00:43:34,069 --> 00:43:32,960
and uh the jezreel and so that of course

1367
00:43:35,990 --> 00:43:34,079
gives us evidence that there was

1368
00:43:37,589 --> 00:43:36,000
sustained water in jezreel

1369
00:43:39,190 --> 00:43:37,599
um but one thing that we haven't talked

1370
00:43:41,349 --> 00:43:39,200
about is that there's a channel

1371
00:43:42,550 --> 00:43:41,359
on the other side of the crater um which

1372
00:43:44,630 --> 00:43:42,560
makes this an um

1373
00:43:46,230 --> 00:43:44,640
what we call sort of an open crater and

1374
00:43:48,309 --> 00:43:46,240
so it's an outflow channel

1375
00:43:49,910 --> 00:43:48,319
and a lot of people do think that it's

1376
00:43:51,109 --> 00:43:49,920
possible that that outflow channel was

1377
00:43:53,030 --> 00:43:51,119
connected to

1378
00:43:54,870 --> 00:43:53,040
a larger ocean in the northern uh

1379
00:43:57,349 --> 00:43:54,880
hemisphere of mars

1380
00:43:58,550 --> 00:43:57,359
and so um it is possible that some of

1381
00:44:00,630 --> 00:43:58,560
the uh

1382
00:44:01,829 --> 00:44:00,640
geological evidence that we see in

1383
00:44:04,790 --> 00:44:01,839
jezreel crater

1384
00:44:06,230 --> 00:44:04,800
particularly thinking about how uh lake

1385
00:44:08,630 --> 00:44:06,240
deposits came and went

1386
00:44:09,990 --> 00:44:08,640
uh i think about the you know if it's

1387
00:44:12,069 --> 00:44:10,000
shallow or deep and

1388
00:44:13,589 --> 00:44:12,079

looking at salts like canada was

1389
00:44:15,589 --> 00:44:13,599
suggesting that we might be able to

1390
00:44:18,309 --> 00:44:15,599
connect what we're seeing with jezreel

1391
00:44:19,750 --> 00:44:18,319
with uh this possible northern ocean and

1392
00:44:21,430 --> 00:44:19,760
we have evidence for that from other

1393
00:44:24,230 --> 00:44:21,440
delta deposits across

1394
00:44:25,829 --> 00:44:24,240
mars and so um and so that's sort of a

1395
00:44:28,230 --> 00:44:25,839
way that we might be able to

1396
00:44:30,230 --> 00:44:28,240
address that question maybe not directly

1397
00:44:31,670 --> 00:44:30,240
but uh sort of indirectly

1398
00:44:33,349 --> 00:44:31,680
and it's awesome yeah just having that

1399
00:44:34,870 --> 00:44:33,359
synergy of studying some things in

1400
00:44:35,750 --> 00:44:34,880
jezreel that could connect to future

1401
00:44:38,470 --> 00:44:35,760
studies as well

1402
00:44:38,790 --> 00:44:38,480
of this northern region of mars uh zvet

1403
00:44:43,990 --> 00:44:38,800
this

1404
00:44:45,829 --> 00:44:44,000
saginet from user andrew r bowman

1405
00:44:47,750 --> 00:44:45,839
andrew wants to know how the precious

1406
00:44:49,190 --> 00:44:47,760
rock samples collected on the mars

1407
00:44:50,069 --> 00:44:49,200
mission and brought back from sample

1408
00:44:52,150 --> 00:44:50,079
return

1409
00:44:53,589 --> 00:44:52,160
how they might be distributed amongst

1410
00:44:55,829 --> 00:44:53,599
the community

1411
00:44:57,750 --> 00:44:55,839
in astrobiology and in science do you

1412
00:44:59,510 --> 00:44:57,760
know do we even have a plan

1413
00:45:02,630 --> 00:44:59,520

yet for that or is that just so far away

1414
00:45:05,190 --> 00:45:02,640
that we're not even quite there yet

1415
00:45:05,910 --> 00:45:05,200
we're in the very very early stages of

1416
00:45:09,270 --> 00:45:05,920
developing

1417
00:45:09,670 --> 00:45:09,280
that plan so not a lot is known about

1418
00:45:12,550 --> 00:45:09,680
that

1419
00:45:15,030 --> 00:45:12,560
um facilities will need to be built for

1420
00:45:18,710 --> 00:45:15,040
that to actually happen as well so

1421
00:45:20,630 --> 00:45:18,720
depending on um a lot of you know

1422
00:45:21,750 --> 00:45:20,640
political questions and a lot of

1423
00:45:25,349 --> 00:45:21,760
questions about

1424
00:45:27,349 --> 00:45:25,359
um contamination protocols and

1425
00:45:28,630 --> 00:45:27,359
for example previous countries um that

1426
00:45:30,630 --> 00:45:28,640
have already had

1427
00:45:32,309 --> 00:45:30,640
um uh the ability to collect

1428
00:45:35,510 --> 00:45:32,319
extraterrestrial samples like

1429
00:45:37,910 --> 00:45:35,520
meteorites and countries

1430
00:45:39,829 --> 00:45:37,920
that are familiar like japan with you

1431
00:45:43,589 --> 00:45:39,839
know analyzing things like solar

1432
00:45:45,270 --> 00:45:43,599
solar dust samples they'll probably

1433
00:45:47,270 --> 00:45:45,280
be at the front of that line but that is

1434
00:45:48,870 --> 00:45:47,280
a great question and yeah it's

1435
00:45:51,270 --> 00:45:48,880
still in process the answer to that

1436
00:45:52,790 --> 00:45:51,280
question i i can also follow up

1437
00:45:55,030 --> 00:45:52,800
what's the answer too yeah i can follow

1438
00:45:59,430 --> 00:45:55,040

up a little bit on that um as well

1439
00:46:01,030 --> 00:45:59,440
um uh now that i i i recently joined um

1440
00:46:03,109 --> 00:46:01,040
the steering committee for the mars

1441
00:46:04,790 --> 00:46:03,119
exploration program assessment group

1442
00:46:06,790 --> 00:46:04,800
and we just had a recent virtual meeting

1443
00:46:08,550 --> 00:46:06,800
where it was announced that the mars

1444
00:46:10,309 --> 00:46:08,560
sample return program office that

1445
00:46:10,950 --> 00:46:10,319
structure nasa has put that structure in

1446
00:46:13,270 --> 00:46:10,960
place

1447
00:46:14,470 --> 00:46:13,280
so we actually have now a focus program

1448
00:46:18,069 --> 00:46:14,480
office whose whole

1449
00:46:21,109 --> 00:46:18,079
job is to focus on sample return

1450
00:46:24,630 --> 00:46:21,119
um and we do have an international

1451
00:46:26,309 --> 00:46:24,640
um team um first we have we have sample

1452
00:46:29,109 --> 00:46:26,319
return scientists that were selected for

1453
00:46:31,349 --> 00:46:29,119
the mars 2020 mission and their whole

1454
00:46:32,470 --> 00:46:31,359
purpose um to be part of the mars 2020

1455
00:46:33,990 --> 00:46:32,480
mission team is

1456
00:46:36,069 --> 00:46:34,000
to help us choose the best samples that

1457
00:46:38,790 --> 00:46:36,079
will get returned we now have another

1458
00:46:39,510 --> 00:46:38,800
um committee that is work that got

1459
00:46:41,589 --> 00:46:39,520
selected

1460
00:46:42,710 --> 00:46:41,599
from both u.s participants and

1461
00:46:45,270 --> 00:46:42,720
internationally

1462
00:46:46,069 --> 00:46:45,280
that they're working on okay once we

1463
00:46:47,349 --> 00:46:46,079

have you know

1464
00:46:49,750 --> 00:46:47,359
how are we going to get these samples

1465
00:46:51,430 --> 00:46:49,760
returned how are we going to manage them

1466
00:46:52,790 --> 00:46:51,440
what do we need to do to manage them

1467
00:46:54,630 --> 00:46:52,800
what do we need to do to

1468
00:46:56,150 --> 00:46:54,640
to partition them so there is a

1469
00:46:56,710 --> 00:46:56,160
committee in place there are people

1470
00:46:58,550 --> 00:46:56,720
working

1471
00:47:00,069 --> 00:46:58,560
on as that said there are there are a

1472
00:47:01,750 --> 00:47:00,079
lot of politics behind it that we have

1473
00:47:05,030 --> 00:47:01,760
to figure out a lot of logistics

1474
00:47:06,150 --> 00:47:05,040
but we do have we are pretty set in this

1475
00:47:08,150 --> 00:47:06,160
course we have

1476
00:47:09,510 --> 00:47:08,160
nasa has committed the resources and in

1477
00:47:11,750 --> 00:47:09,520
the mars for the mars

1478
00:47:13,109 --> 00:47:11,760
sample return program office to make

1479
00:47:14,470 --> 00:47:13,119
sample return happen

1480
00:47:16,470 --> 00:47:14,480
and we've gotten international

1481
00:47:17,750 --> 00:47:16,480
cooperation from our fellow from our

1482
00:47:18,390 --> 00:47:17,760
international scientists in the science

1483
00:47:24,710 --> 00:47:18,400
community

1484
00:47:27,349 --> 00:47:24,720
organizations to um basically

1485
00:47:28,790 --> 00:47:27,359
um participate in sample return so there

1486
00:47:30,309 --> 00:47:28,800
are a lot of questions to be answered

1487
00:47:31,190 --> 00:47:30,319
over the next few years but but we are

1488
00:47:33,910 --> 00:47:31,200

on our way

1489
00:47:35,670 --> 00:47:33,920
to answering those questions i love it

1490
00:47:37,109 --> 00:47:35,680
it reminds me of the of the uh the old

1491
00:47:38,549 --> 00:47:37,119
song from world war one

1492
00:47:41,030 --> 00:47:38,559
i don't know where i'm going but i'm on

1493
00:47:43,030 --> 00:47:41,040
my way um that carl sagan famously loved

1494
00:47:44,870 --> 00:47:43,040
love to quote over and over again

1495
00:47:47,589 --> 00:47:44,880
uh kendall this next question might also

1496
00:47:48,630 --> 00:47:47,599
be for you uh we have elise harrington

1497
00:47:51,670 --> 00:47:48,640
who's user at

1498
00:47:52,309 --> 00:47:51,680
ellusium on twitter very cool name elise

1499
00:47:54,069 --> 00:47:52,319
um

1500
00:47:55,589 --> 00:47:54,079
at least once there's uh so jezreel is

1501
00:47:58,230 --> 00:47:55,599
famous for its beautiful delta

1502
00:48:00,069 --> 00:47:58,240
deposits however on earth deltas can be

1503
00:48:01,270 --> 00:48:00,079
stressful places for organisms because

1504
00:48:02,870 --> 00:48:01,280
they're places where different water

1505
00:48:04,630 --> 00:48:02,880
bodies are mixing

1506
00:48:06,790 --> 00:48:04,640
how do we know what the water chemistry

1507
00:48:09,430 --> 00:48:06,800
flux near percy's landing site

1508
00:48:09,990 --> 00:48:09,440
how it might have changed through time

1509
00:48:11,750 --> 00:48:10,000
uh

1510
00:48:13,109 --> 00:48:11,760
that is a very good question that maybe

1511
00:48:14,950 --> 00:48:13,119
you and francis can help because she

1512
00:48:15,430 --> 00:48:14,960
does more paleo construction work than i

1513
00:48:17,109 --> 00:48:15,440

do

1514
00:48:18,790 --> 00:48:17,119
but i mean a lot of it is just basically

1515
00:48:20,790 --> 00:48:18,800
being able to study the mineralogy of

1516
00:48:22,470 --> 00:48:20,800
the rocks and of the in particular if we

1517
00:48:25,670 --> 00:48:22,480
can get a good view of the

1518
00:48:27,589 --> 00:48:25,680
outcrop of of the delta then we can

1519
00:48:29,109 --> 00:48:27,599
start to get a good understanding of the

1520
00:48:30,950 --> 00:48:29,119
different water sequences because yeah

1521
00:48:32,630 --> 00:48:30,960
especially at a lake environment

1522
00:48:33,990 --> 00:48:32,640
um yeah the water system the water

1523
00:48:35,030 --> 00:48:34,000
chemistry can change over time but the

1524
00:48:35,670 --> 00:48:35,040
beautiful thing about the lake

1525
00:48:39,430 --> 00:48:35,680
environment

1526
00:48:41,510 --> 00:48:39,440
sediment and sedimentary rock

1527
00:48:43,190 --> 00:48:41,520
is very good at capturing and preserving

1528
00:48:44,790 --> 00:48:43,200
also what the water street

1529
00:48:46,309 --> 00:48:44,800
chemistry was in time and we can

1530
00:48:48,309 --> 00:48:46,319
actually kind of figure that out so

1531
00:48:49,430 --> 00:48:48,319
if we can get a good if we get it if we

1532
00:48:51,349 --> 00:48:49,440
get lucky like we did

1533
00:48:53,750 --> 00:48:51,359
in the in the mars exploration rovers

1534
00:48:54,549 --> 00:48:53,760
and drop out right into a pretty exposed

1535
00:48:55,990 --> 00:48:54,559
outcrop

1536
00:48:57,270 --> 00:48:56,000
i i don't know if we'll get that lucky

1537
00:48:57,670 --> 00:48:57,280
but we should be able to drive up to a

1538
00:48:59,430 --> 00:48:57,680

nice

1539
00:49:01,270 --> 00:48:59,440
outcrop and and look at the sedimentary

1540
00:49:02,630 --> 00:49:01,280
sequence then we'll be able to kind of

1541
00:49:05,670 --> 00:49:02,640
actually survey that

1542
00:49:08,390 --> 00:49:05,680
that mineralogy um and and help us

1543
00:49:09,030 --> 00:49:08,400
um understand how the water chemistry

1544
00:49:10,470 --> 00:49:09,040
change

1545
00:49:11,670 --> 00:49:10,480
another great thing about jezreel that i

1546
00:49:13,910 --> 00:49:11,680
want to make sure to let you know about

1547
00:49:15,109 --> 00:49:13,920
is not only do we have an opportunity to

1548
00:49:16,549 --> 00:49:15,119
study um

1549
00:49:18,069 --> 00:49:16,559
and look for biosignatures of life that

1550
00:49:18,790 --> 00:49:18,079
could have existed in the actual open

1551
00:49:20,950 --> 00:49:18,800
lake but

1552
00:49:22,710 --> 00:49:20,960
when that lake water went away we're now

1553
00:49:23,190 --> 00:49:22,720
starting to learn that groundwater was a

1554
00:49:25,589 --> 00:49:23,200
big

1555
00:49:26,790 --> 00:49:25,599
issue and so it's quite possible that

1556
00:49:28,230 --> 00:49:26,800
when the lake water went away there was

1557
00:49:29,190 --> 00:49:28,240
a lot of groundwater moving through

1558
00:49:31,109 --> 00:49:29,200
those sediments that could have

1559
00:49:33,910 --> 00:49:31,119
supported microbial life

1560
00:49:35,190 --> 00:49:33,920
and so um also studying these sediments

1561
00:49:37,510 --> 00:49:35,200
we might be able to get an

1562
00:49:38,950 --> 00:49:37,520
understanding of how much groundwater

1563
00:49:40,710 --> 00:49:38,960

had an influence on those sediments and

1564
00:49:42,470 --> 00:49:40,720
therefore also could have supported

1565
00:49:44,950 --> 00:49:42,480
a basically a shallow subsurface

1566
00:49:46,390 --> 00:49:44,960
ecosystem after the main lake went away

1567
00:49:48,309 --> 00:49:46,400
so we have a lot of things that we'll be

1568
00:49:49,190 --> 00:49:48,319
able to learn once we can get up to that

1569
00:49:50,710 --> 00:49:49,200
rock and take a

1570
00:49:52,390 --> 00:49:50,720
really good look at those out those

1571
00:49:54,069 --> 00:49:52,400
exposed outcrops and

1572
00:49:56,390 --> 00:49:54,079
if i missed anything francis please jump

1573
00:49:57,750 --> 00:49:56,400
in i love it so much actually francis if

1574
00:49:58,069 --> 00:49:57,760
i can i'd like you to answer that

1575
00:49:59,510 --> 00:49:58,079
question

1576
00:50:01,430 --> 00:49:59,520
as well as our next one at the same time

1577
00:50:03,190 --> 00:50:01,440
if you don't mind because ricardo

1578
00:50:04,950 --> 00:50:03,200
cabrera is also interested

1579
00:50:06,790 --> 00:50:04,960
in jezreel ricardo wants to know what

1580
00:50:09,270 --> 00:50:06,800
the source of water could be

1581
00:50:09,990 --> 00:50:09,280
as well that filled jezero could it have

1582
00:50:11,589 --> 00:50:10,000
been rain

1583
00:50:13,190 --> 00:50:11,599
falling from mountains or was there

1584
00:50:15,190 --> 00:50:13,200
another source for water

1585
00:50:16,549 --> 00:50:15,200
in the ancient history of mars uh if you

1586
00:50:17,670 --> 00:50:16,559
wouldn't mind speaking to both of those

1587
00:50:20,069 --> 00:50:17,680
things

1588
00:50:20,870 --> 00:50:20,079

yeah sure so um i thought that canada

1589
00:50:22,230 --> 00:50:20,880
did a great job

1590
00:50:24,470 --> 00:50:22,240
answering that question the only thing i

1591
00:50:27,349 --> 00:50:24,480
would add is that the

1592
00:50:27,829 --> 00:50:27,359
the watershed for the jezreel crater

1593
00:50:30,309 --> 00:50:27,839
delta

1594
00:50:31,510 --> 00:50:30,319
so the other tributaries in the other

1595
00:50:33,349 --> 00:50:31,520
parts of the stream

1596
00:50:35,670 --> 00:50:33,359
uh that feed into that main river

1597
00:50:36,630 --> 00:50:35,680
channel um also are sourcing other

1598
00:50:38,470 --> 00:50:36,640
environments

1599
00:50:40,790 --> 00:50:38,480
and so though all of those channels are

1600
00:50:43,829 --> 00:50:40,800
also uh might potentially be

1601
00:50:45,270 --> 00:50:43,839
um transporting uh uh

1602
00:50:47,109 --> 00:50:45,280
signals for biosingers from other

1603
00:50:49,829 --> 00:50:47,119
locations and then being deposited

1604
00:50:51,670 --> 00:50:49,839
in the actual delta and then the crater

1605
00:50:53,190 --> 00:50:51,680
uh lake itself and so

1606
00:50:55,270 --> 00:50:53,200
and so that's another reason that we

1607
00:50:56,390 --> 00:50:55,280
went to jezreel and why we think this is

1608
00:50:57,990 --> 00:50:56,400
a good place because

1609
00:50:59,430 --> 00:50:58,000
in addition to both of the things that

1610
00:51:00,950 --> 00:50:59,440
uh kendall mentioned we have an

1611
00:51:03,510 --> 00:51:00,960
opportunity to trap

1612
00:51:04,630 --> 00:51:03,520
um uh information from all of the uh

1613
00:51:06,950 --> 00:51:04,640

upland regions

1614
00:51:08,870 --> 00:51:06,960
um and so um so it's kind of like a

1615
00:51:10,069 --> 00:51:08,880
trash can right it's just like grab all

1616
00:51:12,950 --> 00:51:10,079
for everything

1617
00:51:13,589 --> 00:51:12,960
um as far as the water um that's a very

1618
00:51:14,710 --> 00:51:13,599
good question

1619
00:51:16,470 --> 00:51:14,720
that's one of the things that i was

1620
00:51:17,670 --> 00:51:16,480
alluding to that we we still don't have

1621
00:51:20,710 --> 00:51:17,680
a good handle

1622
00:51:23,990 --> 00:51:20,720
for what the source of water uh

1623
00:51:24,630 --> 00:51:24,000
was on early mars a common and i think

1624
00:51:28,150 --> 00:51:24,640
the most

1625
00:51:29,750 --> 00:51:28,160
uh popular theory is that uh potentially

1626
00:51:32,309 --> 00:51:29,760
snow accumulated

1627
00:51:32,790 --> 00:51:32,319
in uh topographic highs and then the

1628
00:51:36,069 --> 00:51:32,800
snow

1629
00:51:37,430 --> 00:51:36,079
uh melted uh allowing um you know giving

1630
00:51:40,630 --> 00:51:37,440
a source for

1631
00:51:42,390 --> 00:51:40,640
um uh running uh liquid water

1632
00:51:43,670 --> 00:51:42,400
um there's also a lot of evidence for

1633
00:51:46,309 --> 00:51:43,680
groundwater uh

1634
00:51:47,670 --> 00:51:46,319
flow just as kenda was talking about and

1635
00:51:49,030 --> 00:51:47,680
so a lot of people think that it caught

1636
00:51:51,349 --> 00:51:49,040
a bit could have been a contribution

1637
00:51:52,390 --> 00:51:51,359
from both so not only precipitation from

1638
00:51:54,309 --> 00:51:52,400

rain or snow

1639
00:51:55,430 --> 00:51:54,319
but also this groundwater and as i

1640
00:51:57,670 --> 00:51:55,440
mentioned i think

1641
00:51:59,190 --> 00:51:57,680
the leading hypothesis also based on

1642
00:52:01,510 --> 00:51:59,200
what we know from climate models

1643
00:52:02,710 --> 00:52:01,520
is that it's most likely snow that then

1644
00:52:06,069 --> 00:52:02,720
later melted with

1645
00:52:07,589 --> 00:52:06,079
heating events um yeah but that's again

1646
00:52:08,790 --> 00:52:07,599
it's an ongoing question and that's why

1647
00:52:10,710 --> 00:52:08,800
it's exciting to go

1648
00:52:12,390 --> 00:52:10,720
to another location to be able to test

1649
00:52:14,710 --> 00:52:12,400
uh

1650
00:52:16,710 --> 00:52:14,720
this hypothesis so that's awesome yeah

1651
00:52:18,470 --> 00:52:16,720
it makes me feel you know a little happy

1652
00:52:19,349 --> 00:52:18,480
for the future generation of explorers

1653
00:52:20,870 --> 00:52:19,359
who are going to

1654
00:52:22,549 --> 00:52:20,880
learn so much more we have all these

1655
00:52:24,150 --> 00:52:22,559
ongoing questions

1656
00:52:26,309 --> 00:52:24,160
that kind of keep us curious and wanting

1657
00:52:28,630 --> 00:52:26,319
to know this next question

1658
00:52:30,790 --> 00:52:28,640
uh so uh in our audience right now

1659
00:52:33,910 --> 00:52:30,800
someone is watching named philip fox

1660
00:52:35,270 --> 00:52:33,920
on facebook and phillips young son lucas

1661
00:52:37,670 --> 00:52:35,280
is in sixth grade

1662
00:52:38,870 --> 00:52:37,680
and also watching and lucas wants to

1663
00:52:40,950 --> 00:52:38,880

know two things and

1664
00:52:43,270 --> 00:52:40,960
maybe all three of you could speak to it

1665
00:52:45,109 --> 00:52:43,280
um one lucas wants to know and again

1666
00:52:46,630 --> 00:52:45,119
in sixth grade how to become an

1667
00:52:48,549 --> 00:52:46,640
astrobiologist

1668
00:52:50,309 --> 00:52:48,559
and then maybe just for fun lucas also

1669
00:52:52,309 --> 00:52:50,319
wants to know if humans will ever be

1670
00:52:53,990 --> 00:52:52,319
able to visit exoplanets

1671
00:52:55,670 --> 00:52:54,000
um and so those are two really good

1672
00:52:57,430 --> 00:52:55,680
questions lucas and thank you very much

1673
00:53:00,069 --> 00:52:57,440
for those uh zvet i think i'll throw it

1674
00:53:01,349 --> 00:53:00,079
to you first if you don't mind

1675
00:53:03,990 --> 00:53:01,359
i think all of us who come to

1676
00:53:07,589 --> 00:53:04,000
astrobiology have followed a very unique

1677
00:53:10,069 --> 00:53:07,599
and roundabout pathway so i'd say

1678
00:53:10,630 --> 00:53:10,079
follow your passion just ask the

1679
00:53:14,069 --> 00:53:10,640
questions

1680
00:53:16,069 --> 00:53:14,079
stay curious and you never know what

1681
00:53:17,510 --> 00:53:16,079
unique skills and interests of yours

1682
00:53:19,349 --> 00:53:17,520
will end up being

1683
00:53:20,870 --> 00:53:19,359
needed by the field of astrobiology

1684
00:53:21,829 --> 00:53:20,880
because it takes more than just the

1685
00:53:24,790 --> 00:53:21,839
researchers right

1686
00:53:26,230 --> 00:53:24,800
astrobiology takes the communicators the

1687
00:53:29,589 --> 00:53:26,240
business managers

1688
00:53:31,349 --> 00:53:29,599

the folks thinking about ethics um

1689
00:53:33,190 --> 00:53:31,359
of you know settling on other planets it

1690
00:53:36,150 --> 00:53:33,200
also takes you know the folks building

1691
00:53:37,910 --> 00:53:36,160
the rovers and and um asking the

1692
00:53:39,190 --> 00:53:37,920
scientific questions about land you know

1693
00:53:42,390 --> 00:53:39,200
landforms and

1694
00:53:43,030 --> 00:53:42,400
deltas on mars so figure out which of

1695
00:53:44,870 --> 00:53:43,040
those

1696
00:53:46,950 --> 00:53:44,880
pathways you want to pursue and don't be

1697
00:53:51,190 --> 00:53:46,960
afraid to follow a slightly

1698
00:53:54,790 --> 00:53:51,200
less traditional pathway to get there

1699
00:53:56,549 --> 00:53:54,800
as for exoplanets i hope so

1700
00:53:59,349 --> 00:53:56,559
i hope so i don't think it'll be in our

1701
00:54:01,510 --> 00:53:59,359
lifetimes but i i definitely am with you

1702
00:54:02,549 --> 00:54:01,520
in hoping that one day we can make it

1703
00:54:04,950 --> 00:54:02,559
there

1704
00:54:07,270 --> 00:54:04,960
i love it kenda how about you uh what

1705
00:54:08,870 --> 00:54:07,280
would you say to lucas in sixth grade

1706
00:54:11,190 --> 00:54:08,880
on how to become an astrobiologist and

1707
00:54:13,349 --> 00:54:11,200
whether we'll ever travel to exoplanets

1708
00:54:14,390 --> 00:54:13,359
um lucas what i can say is i agree with

1709
00:54:17,270 --> 00:54:14,400
svet there are

1710
00:54:18,309 --> 00:54:17,280
so many astrobiology is truly an

1711
00:54:21,510 --> 00:54:18,319
integrated scientist

1712
00:54:24,470 --> 00:54:21,520
it takes every bit

1713
00:54:26,150 --> 00:54:24,480

of every different discipline of science

1714
00:54:27,990 --> 00:54:26,160
to do astrobiology because we need input

1715
00:54:30,870 --> 00:54:28,000
from everybody because it's such a big

1716
00:54:32,309 --> 00:54:30,880
question um and and that includes the

1717
00:54:34,309 --> 00:54:32,319
engineers and if we're going to go to an

1718
00:54:35,750 --> 00:54:34,319
exoplanet lucas we need

1719
00:54:37,510 --> 00:54:35,760
young people like you to be interested

1720
00:54:38,710 --> 00:54:37,520
in engineering so you can develop the

1721
00:54:41,430 --> 00:54:38,720
engines that'll get us to

1722
00:54:44,150 --> 00:54:41,440
another solar system so maybe

1723
00:54:45,510 --> 00:54:44,160
engineering's in your future

1724
00:54:46,470 --> 00:54:45,520
i love it i love that you bring the

1725
00:54:47,829 --> 00:54:46,480
expertise of engineering and

1726
00:54:49,349 --> 00:54:47,839
astrobiology

1727
00:54:51,190 --> 00:54:49,359
and that could be part of lucas's future

1728
00:54:53,190 --> 00:54:51,200
is engineering that that for us

1729
00:54:54,230 --> 00:54:53,200
uh francis how about you what what

1730
00:54:55,910 --> 00:54:54,240
should lucas do to become an

1731
00:54:56,870 --> 00:54:55,920
astrobiologist if that's the career he

1732
00:55:01,589 --> 00:54:56,880
ends up choosing

1733
00:55:03,430 --> 00:55:01,599
uh and will we travel to exoplanets um

1734
00:55:04,789 --> 00:55:03,440
i would say something very similar as

1735
00:55:06,230 --> 00:55:04,799
kenda and svet you know

1736
00:55:08,390 --> 00:55:06,240
like be true to yourself don't

1737
00:55:10,150 --> 00:55:08,400
compromise yourself ask a lot of

1738
00:55:10,789 --> 00:55:10,160

questions i think a lot of people think

1739
00:55:11,990 --> 00:55:10,799
that

1740
00:55:13,270 --> 00:55:12,000
even though we're scientists we don't

1741
00:55:14,309 --> 00:55:13,280
ask questions but that's literally our

1742
00:55:16,549 --> 00:55:14,319
job

1743
00:55:18,950 --> 00:55:16,559
is to learn more you don't only you only

1744
00:55:21,829 --> 00:55:18,960
learn more by asking questions and so

1745
00:55:22,470 --> 00:55:21,839
uh yeah don't be scared to ask questions

1746
00:55:25,109 --> 00:55:22,480
and then try

1747
00:55:25,750 --> 00:55:25,119
uh new things and so as as kenda

1748
00:55:29,109 --> 00:55:25,760
mentioned

1749
00:55:30,630 --> 00:55:29,119
uh and also svet um it takes a lot of

1750
00:55:32,549 --> 00:55:30,640
people with different disciplines to

1751
00:55:34,390 --> 00:55:32,559
really bring astrobiology together

1752
00:55:35,829 --> 00:55:34,400
and figuring out how you fit into that

1753
00:55:38,150 --> 00:55:35,839
picture um

1754
00:55:39,270 --> 00:55:38,160
only happens by trying different things

1755
00:55:41,750 --> 00:55:39,280
and trying different hats

1756
00:55:42,390 --> 00:55:41,760
and and so yeah take every opportunity

1757
00:55:43,750 --> 00:55:42,400
that you can get

1758
00:55:45,589 --> 00:55:43,760
to really constrain what you like and

1759
00:55:46,870 --> 00:55:45,599
what you don't like and

1760
00:55:48,630 --> 00:55:46,880
keep asking questions because that's

1761
00:55:51,750 --> 00:55:48,640
ultimately what a scientist

1762
00:55:53,270 --> 00:55:51,760
is and what we do is uh ask good

1763
00:55:56,230 --> 00:55:53,280

questions

1764
00:55:58,309 --> 00:55:56,240
and and i don't think yeah and as far as

1765
00:55:59,670 --> 00:55:58,319
exoplanets yeah i agree with kenda we

1766
00:56:01,030 --> 00:55:59,680
need really good engineers and so if

1767
00:56:03,829 --> 00:56:01,040
you're really interested in getting

1768
00:56:04,950 --> 00:56:03,839
to an exoplanet um figuring out the

1769
00:56:07,990 --> 00:56:04,960
engineering to do that

1770
00:56:09,670 --> 00:56:08,000
might be in your in your future

1771
00:56:11,349 --> 00:56:09,680
i love it well thank all all three of

1772
00:56:12,789 --> 00:56:11,359
you so much for joining us for ask an

1773
00:56:14,710 --> 00:56:12,799
astrobiologist

1774
00:56:16,630 --> 00:56:14,720
for our audience right now watching we

1775
00:56:18,150 --> 00:56:16,640
had a lot more questions i'm so sorry we

1776
00:56:20,309 --> 00:56:18,160
couldn't get to all of them

1777
00:56:21,990 --> 00:56:20,319
my advice would be to reach out to

1778
00:56:24,710 --> 00:56:22,000
francis and kenda and zvet

1779
00:56:26,630 --> 00:56:24,720
online and ask them more questions and

1780
00:56:27,750 --> 00:56:26,640
get involved in the conversation join us

1781
00:56:30,309 --> 00:56:27,760
on saginet

1782
00:56:30,870 --> 00:56:30,319
join us at nasa astrobiology's facebook

1783
00:56:32,950 --> 00:56:30,880
page

1784
00:56:35,190 --> 00:56:32,960
and on twitter and ask your questions

1785
00:56:37,670 --> 00:56:35,200
there uh and if you'd like to stay

1786
00:56:39,270 --> 00:56:37,680
involved and in the loop on upcoming

1787
00:56:40,870 --> 00:56:39,280
episodes of our show

1788
00:56:42,630 --> 00:56:40,880

upcoming opportunities for young

1789
00:56:43,430 --> 00:56:42,640
scientists early career researchers and

1790
00:56:45,910 --> 00:56:43,440
those interested in

1791
00:56:46,549 --> 00:56:45,920
astrobiology right now our producer

1792
00:56:49,030 --> 00:56:46,559
director

1793
00:56:50,789 --> 00:56:49,040
mike toyan is going to put up a slide

1794
00:56:53,510 --> 00:56:50,799
with information for how to join the

1795
00:56:54,789 --> 00:56:53,520
nasa astrobiology mailing list

1796
00:56:57,190 --> 00:56:54,799
we recently just just changed the

1797
00:56:58,789 --> 00:56:57,200
mailing list over to a new format and so

1798
00:57:00,630 --> 00:56:58,799
uh we're getting a lot more emails out

1799
00:57:02,309 --> 00:57:00,640
there now a lot more information

1800
00:57:03,990 --> 00:57:02,319
of ways that you can be involved in all

1801
00:57:07,109 --> 00:57:04,000
the things that we're doing

1802
00:57:09,030 --> 00:57:07,119
uh and then also since we have you know

1803
00:57:10,789 --> 00:57:09,040
it's incredible three missions getting

1804
00:57:12,710 --> 00:57:10,799
to mars in the next three weeks i mean

1805
00:57:14,950 --> 00:57:12,720
it's so big right three new missions at

1806
00:57:16,549 --> 00:57:14,960
mars and one short window

1807
00:57:19,190 --> 00:57:16,559
including perseverance landing on the

1808
00:57:22,150 --> 00:57:19,200
18th if you'd like to know more

1809
00:57:23,349 --> 00:57:22,160
about perseverance and the mission about

1810
00:57:26,390 --> 00:57:23,359
mars science

1811
00:57:28,230 --> 00:57:26,400
there's a huge amount of resources

1812
00:57:30,069 --> 00:57:28,240
and information on events surrounding

1813
00:57:31,430 --> 00:57:30,079

the mars 2020 landing surrounding

1814
00:57:35,190 --> 00:57:31,440
perseverance

1815
00:57:40,470 --> 00:57:35,200
if you visit go.nasa.gov

1816
00:57:43,910 --> 00:57:40,480
mars 2020 toolkit that's go.nasa.gov

1817
00:57:44,950 --> 00:57:43,920
mars 2020 toolkit you can find posters

1818
00:57:48,069 --> 00:57:44,960
and stickers

1819
00:57:50,710 --> 00:57:48,079
and mission patches a mars photo booth

1820
00:57:52,549 --> 00:57:50,720
and a bunch of guides on where to watch

1821
00:57:54,390 --> 00:57:52,559
all of the different broadcasts

1822
00:57:55,670 --> 00:57:54,400
not only of the landing but also leading

1823
00:57:58,549 --> 00:57:55,680
up to landing day

1824
00:57:59,190 --> 00:57:58,559
nasa astrobiology and nasa have so many

1825
00:58:01,030 --> 00:57:59,200
things

1826
00:58:02,549 --> 00:58:01,040
uh going on here in the next few weeks

1827
00:58:04,150 --> 00:58:02,559
as we get ready for these missions

1828
00:58:05,670 --> 00:58:04,160
i know all three of our panelists are

1829
00:58:07,190 --> 00:58:05,680
also super excited and probably going to

1830
00:58:09,829 --> 00:58:07,200
be involved in a bunch of other events

1831
00:58:12,309 --> 00:58:09,839
as well as all of us get ready for

1832
00:58:14,069 --> 00:58:12,319
for this to happen so uh one more time

1833
00:58:17,430 --> 00:58:14,079
francis kenda and vet thank you so much

1834
00:58:19,349 --> 00:58:17,440
for joining us for ask an astrobiologist

1835
00:58:21,589 --> 00:58:19,359
all right and then to our audience thank

1836
00:58:23,109 --> 00:58:21,599
you to all of you for joining and until

1837
00:58:37,140 --> 00:58:23,119
next time remember