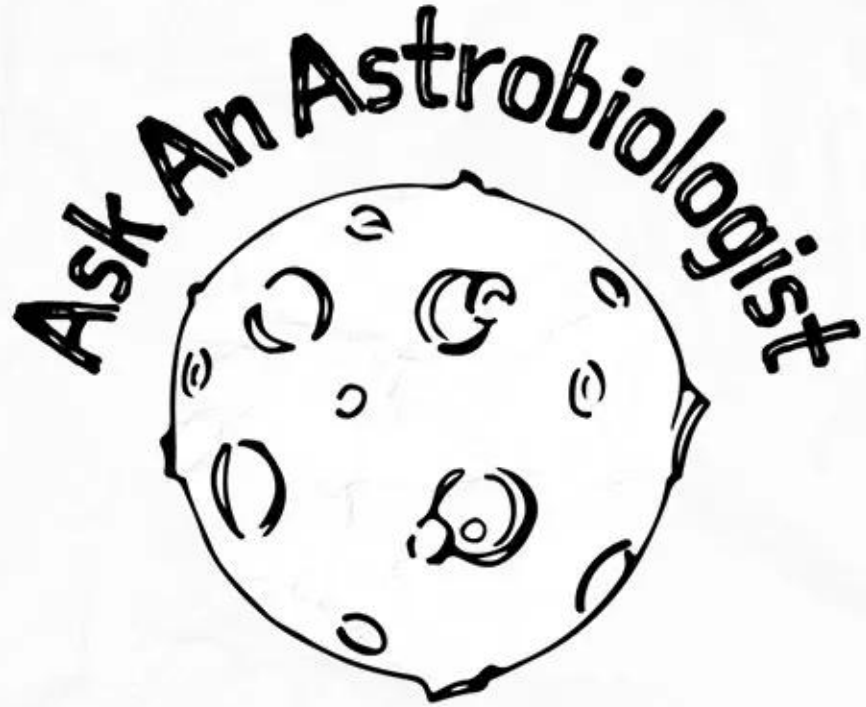

Episode 8: August 31st, 2017

Dr. Darlene Lim

NASA Astrobiology Program

1
00:00:00,510 --> 00:00:30,189
[Music]

2
00:00:34,430 --> 00:00:32,209
greetings friends of astrobiology

3
00:00:36,650 --> 00:00:34,440
welcome to a brand-new episode of ask

4
00:00:38,209 --> 00:00:36,660
and astrobiologist a show where we

5
00:00:40,069 --> 00:00:38,219
celebrate science and celebrate

6
00:00:41,389 --> 00:00:40,079
scientists my name is Sanjay zoom and

7
00:00:43,400 --> 00:00:41,399
this program is made possible by

8
00:00:45,049 --> 00:00:43,410
contributions from Elsie

9
00:00:47,779 --> 00:00:45,059
the earth Life Science Institute at

10
00:00:50,119 --> 00:00:47,789
Tokyo Tech the NASA Astrobiology program

11
00:00:52,010 --> 00:00:50,129
and the nonprofit blue Marlo space if

12
00:00:54,619 --> 00:00:52,020
you have any questions for our speaker

13
00:00:57,560 --> 00:00:54,629

our guests today make sure you use the

14
00:01:01,099 --> 00:00:57,570
hashtag ask Astro bio on Twitter or use

15
00:01:02,810 --> 00:01:01,109
the Signet chat room on sega net org so

16
00:01:05,469 --> 00:01:02,820
we're very excited to have our guest

17
00:01:07,010 --> 00:01:05,479
today dr. Darlene Lim who is an amazing

18
00:01:09,530 --> 00:01:07,020
astrobiologists who works at the

19
00:01:12,320 --> 00:01:09,540
intersection of science technology and

20
00:01:15,320 --> 00:01:12,330
operations it's a new venue for us and

21
00:01:18,080 --> 00:01:15,330
but before we start it is time for your

22
00:01:19,910 --> 00:01:18,090
monthly background quiz so Mike if you

23
00:01:22,520 --> 00:01:19,920
can put up the background from last

24
00:01:26,359 --> 00:01:22,530
month give you a second or two to do

25
00:01:28,580 --> 00:01:26,369
that and it was of course the giant Red

26
00:01:30,679 --> 00:01:28,590
Spot on Jupiter which is a huge

27
00:01:31,730 --> 00:01:30,689
hurricane and our thoughts go to those

28
00:01:34,640 --> 00:01:31,740
of you who are going through hurricane

29
00:01:37,670 --> 00:01:34,650
Harvey but on Jupiter this this

30
00:01:39,890 --> 00:01:37,680
hurricane is about ten thousand miles

31
00:01:41,690 --> 00:01:39,900
wide so sixteen thousand kilometers wide

32
00:01:43,880 --> 00:01:41,700
that's wider than Earth so just a

33
00:01:46,130 --> 00:01:43,890
gigantic storm on this gigantically

34
00:01:48,410 --> 00:01:46,140
beautiful planet so with that

35
00:01:49,819 --> 00:01:48,420
Darlene thank you so much for taking the

36
00:01:52,520 --> 00:01:49,829
time to speak with us today I know

37
00:01:55,069 --> 00:01:52,530
you're very busy and but like we like to

38
00:01:57,170 --> 00:01:55,079

do in the show is is go back to wheels

39
00:01:59,270 --> 00:01:57,180
of to turn back the wheels of time and

40
00:02:03,800 --> 00:01:59,280
could you give us a feeling of how the

41
00:02:05,090 --> 00:02:03,810
scientists Darlene came to be Wow well

42
00:02:06,319 --> 00:02:05,100
first of all thank you so much for

43
00:02:09,499 --> 00:02:06,329
having me on the show it really is a

44
00:02:12,229 --> 00:02:09,509
pleasure and yeah I mean so little

45
00:02:13,230 --> 00:02:12,239
Darlene spent a lot of time outside my

46
00:02:14,610 --> 00:02:13,240
parents came over

47
00:02:17,070 --> 00:02:14,620
immigrants to North America actually

48
00:02:18,690 --> 00:02:17,080
specifically Canada where I grew up from

49
00:02:20,970 --> 00:02:18,700
Singapore and the first thing they

50
00:02:22,440 --> 00:02:20,980
wanted to make sure they do or what the

51
00:02:24,450 --> 00:02:22,450
thing they wanted to prioritize is that

52
00:02:26,760 --> 00:02:24,460
we really embrace this new country and

53
00:02:28,200 --> 00:02:26,770
of course just getting outside and being

54
00:02:30,270 --> 00:02:28,210
part of the environment as much as

55
00:02:33,390 --> 00:02:30,280
possible and all the seasons was very

56
00:02:34,980 --> 00:02:33,400
impactful to me and so you know as a mom

57
00:02:37,710 --> 00:02:34,990
I try and continue to do that with my

58
00:02:39,540 --> 00:02:37,720
kids and I hope that you know that that

59
00:02:40,920 --> 00:02:39,550
makes an impression as well but the

60
00:02:42,480 --> 00:02:40,930
other kind of flipside of being an

61
00:02:44,550 --> 00:02:42,490
immigrant scared is that you're kind of

62
00:02:46,080 --> 00:02:44,560
left by yourself a lot because they got

63
00:02:49,050 --> 00:02:46,090

to work right they got to make ends meet

64
00:02:51,060 --> 00:02:49,060
and so I also ended up watching TV not

65
00:02:54,000 --> 00:02:51,070
really doing what I was supposed to do

66
00:02:55,800 --> 00:02:54,010
all the time and but the good thing

67
00:02:57,990 --> 00:02:55,810
about the TV is that there was yaku's

68
00:03:00,960 --> 00:02:58,000
fest Jacque Cousteau specials on and

69
00:03:03,090 --> 00:03:00,970
those were very impactful yeah I mean

70
00:03:05,160 --> 00:03:03,100
like you know it made a big difference I

71
00:03:07,860 --> 00:03:05,170
couldn't believe that this dude could go

72
00:03:09,840 --> 00:03:07,870
do this job or he got to explore the

73
00:03:11,790 --> 00:03:09,850
unknown and then you know have this

74
00:03:13,440 --> 00:03:11,800
additional benefit in his life of being

75
00:03:17,010 --> 00:03:13,450
able to share that out with so many

76
00:03:19,800 --> 00:03:17,020
different people so all of those two

77
00:03:21,990 --> 00:03:19,810
influences as a child I think made a big

78
00:03:25,170 --> 00:03:22,000
difference to me and and so I knew I

79
00:03:26,880 --> 00:03:25,180
wanted to be part of the natural

80
00:03:28,950 --> 00:03:26,890
environment I wanted to explore there

81
00:03:30,420 --> 00:03:28,960
was no specific job like that that my

82
00:03:31,890 --> 00:03:30,430
high school counselor could come up with

83
00:03:34,950 --> 00:03:31,900
so there were other things that I got

84
00:03:37,260 --> 00:03:34,960
you know into along the way but

85
00:03:39,510 --> 00:03:37,270
eventually made my way down to two aims

86
00:03:41,480 --> 00:03:39,520
here and I've had the joy of doing what

87
00:03:43,710 --> 00:03:41,490
I do for you know about a decade now

88
00:03:46,650 --> 00:03:43,720

that's fantastic that was a big fan of

89
00:03:47,880 --> 00:03:46,660
jack Cousteau and myself but before he

90
00:03:52,230 --> 00:03:47,890
came to Ames you went through school

91
00:03:54,810 --> 00:03:52,240
presumably a little bit of that of that

92
00:03:57,330 --> 00:03:54,820
path and they're like how did you choose

93
00:03:59,280 --> 00:03:57,340
no astrobiologist path is linear right

94
00:04:01,700 --> 00:03:59,290
well I'm sure you went through side ways

95
00:04:05,700 --> 00:04:01,710
to get there give us a sense of that

96
00:04:08,190 --> 00:04:05,710
okay so actually you know if I go back

97
00:04:10,140 --> 00:04:08,200
even further before I got to college the

98
00:04:12,180 --> 00:04:10,150
thing that I really got fascinated with

99
00:04:14,750 --> 00:04:12,190
I was fascinated with the sciences I had

100
00:04:17,729 --> 00:04:14,760
some really great science teachers and

101
00:04:18,930 --> 00:04:17,739
the other thing is I loved ballet so it

102
00:04:21,120 --> 00:04:18,940
was one of those things that I think I

103
00:04:22,670 --> 00:04:21,130
was really fixated on and the irony is

104
00:04:24,900 --> 00:04:22,680
even though that kind of you know

105
00:04:25,500 --> 00:04:24,910
dissipated in terms of its priority in

106
00:04:26,230 --> 00:04:25,510
my life

107
00:04:28,180 --> 00:04:26,240
it

108
00:04:31,089 --> 00:04:28,190
ended up happening is all those

109
00:04:33,400 --> 00:04:31,099
experiences of being on stage and having

110
00:04:35,529 --> 00:04:33,410
to be part of your over her CIL's and

111
00:04:38,439 --> 00:04:35,539
memorizing things it actually impact it

112
00:04:39,969 --> 00:04:38,449
has an impact on lasted because now I

113
00:04:42,969 --> 00:04:39,979

have to get out give so many talks and

114
00:04:44,409 --> 00:04:42,979
so it sort of familiarized me you know

115
00:04:46,480 --> 00:04:44,419
with the with the element of actually

116
00:04:48,219 --> 00:04:46,490
presentation and so I'm saying this just

117
00:04:50,830 --> 00:04:48,229
to go back in time because I think

118
00:04:53,200 --> 00:04:50,840
sometimes we forget that like you know

119
00:04:55,330 --> 00:04:53,210
the journey is is really important and

120
00:04:57,730 --> 00:04:55,340
it sort of takes you to a certain point

121
00:04:59,770 --> 00:04:57,740
in time and the dots of course when you

122
00:05:00,909 --> 00:04:59,780
look back but every experience whether

123
00:05:02,559 --> 00:05:00,919
large or small

124
00:05:06,120 --> 00:05:02,569
I think ends up staying with you in some

125
00:05:10,059 --> 00:05:06,130
way and and scholastically I actually

126
00:05:12,460 --> 00:05:10,069
first enrolled in commerce because again

127
00:05:14,020 --> 00:05:12,470
you know you don't really get the advice

128
00:05:16,089 --> 00:05:14,030
necessarily when you're in high school

129
00:05:18,850 --> 00:05:16,099
where somebody can say oh maybe maybe

130
00:05:21,040 --> 00:05:18,860
now because astrobiology has become so a

131
00:05:23,140 --> 00:05:21,050
more mainstream than it was before and

132
00:05:24,969 --> 00:05:23,150
these sort of integrated sciences but I

133
00:05:26,920 --> 00:05:24,979
think there was so many traditional

134
00:05:28,089 --> 00:05:26,930
there are only so many traditional paths

135
00:05:29,800 --> 00:05:28,099
that were offered up and they were

136
00:05:32,350 --> 00:05:29,810
terribly traditional when I was younger

137
00:05:36,070 --> 00:05:32,360
so I ended up in commerce and then took

138
00:05:38,110 --> 00:05:36,080

biology as an elective and found that I

139
00:05:41,770 --> 00:05:38,120
actually loved that the most and so then

140
00:05:44,830 --> 00:05:41,780
switched and went into biology and over

141
00:05:46,120 --> 00:05:44,840
the course of college I took a variety

142
00:05:49,659 --> 00:05:46,130
of different classes you know in

143
00:05:52,300 --> 00:05:49,669
genetics microbiology etymology like all

144
00:05:54,610 --> 00:05:52,310
sorts of things but the class that I'm

145
00:05:56,320 --> 00:05:54,620
the most I think I loved it so much for

146
00:05:57,760 --> 00:05:56,330
two reasons is because the professor

147
00:06:00,730 --> 00:05:57,770
John small who's at Queen's University

148
00:06:03,459 --> 00:06:00,740
in Canada still is so charismatic and he

149
00:06:05,080 --> 00:06:03,469
made everything so palatable so

150
00:06:07,779 --> 00:06:05,090
interesting and he was just so

151
00:06:09,339 --> 00:06:07,789
passionate about what he was doing and

152
00:06:11,320 --> 00:06:09,349
so you you couldn't help but kind of be

153
00:06:14,620 --> 00:06:11,330
affected by that and then the other

154
00:06:16,990 --> 00:06:14,630
element is that he was he's a specialist

155
00:06:18,610 --> 00:06:17,000
in limnology and paleo limnology which

156
00:06:21,040 --> 00:06:18,620
is the study of freshwater systems in

157
00:06:22,890 --> 00:06:21,050
the history of freshwater systems and up

158
00:06:26,110 --> 00:06:22,900
to that point in time a lot of the

159
00:06:29,279 --> 00:06:26,120
courses that I took were in sort of the

160
00:06:32,170 --> 00:06:29,289
you know very basic kind of science

161
00:06:35,680 --> 00:06:32,180
pathways and then here was this science

162
00:06:37,540 --> 00:06:35,690
that took you know the the kind of that

163
00:06:39,650 --> 00:06:37,550

the basic coursework that I was doing

164
00:06:41,570 --> 00:06:39,660
but then had a direct apple

165
00:06:44,720 --> 00:06:41,580
patient to understanding the environment

166
00:06:46,190 --> 00:06:44,730
and at that time the discussion of the

167
00:06:49,520 --> 00:06:46,200
impacts of climate change or climate

168
00:06:52,430 --> 00:06:49,530
change in general was still nascent as

169
00:06:55,010 --> 00:06:52,440
compared to what it is now and so it was

170
00:06:56,750 --> 00:06:55,020
this new application of knowledge that

171
00:06:58,550 --> 00:06:56,760
that you know I was slowly starting to

172
00:07:00,470 --> 00:06:58,560
build up through college that was very

173
00:07:03,070 --> 00:07:00,480
attractive to me and that's what I ended

174
00:07:05,360 --> 00:07:03,080
up doing in graduate school is actually

175
00:07:07,700 --> 00:07:05,370
paleo limnology and limnology work in

176
00:07:09,440 --> 00:07:07,710
the High Arctic of Canada and it was it

177
00:07:12,170 --> 00:07:09,450
was primarily because of this one course

178
00:07:14,330 --> 00:07:12,180
that really excited me that's so cool

179
00:07:18,740 --> 00:07:14,340
nolan ology is the study of sediments

180
00:07:21,830 --> 00:07:18,750
and lakes what can you tell was mud so

181
00:07:23,270 --> 00:07:21,840
you can you know what it's it's so funny

182
00:07:25,760 --> 00:07:23,280
because it just seems like it's just mud

183
00:07:28,790 --> 00:07:25,770
but but any sedimentary environment will

184
00:07:30,800 --> 00:07:28,800
will build up like the pages of you know

185
00:07:32,570 --> 00:07:30,810
or I should say the layers of a cake and

186
00:07:34,430 --> 00:07:32,580
so the bottom layer is when you pour

187
00:07:36,800 --> 00:07:34,440
first and then you know the top layer

188
00:07:39,440 --> 00:07:36,810

and whipped cream is is of course the

189
00:07:42,020 --> 00:07:39,450
last layer that you that you put on but

190
00:07:43,820 --> 00:07:42,030
then if you have that cake you know sit

191
00:07:45,740 --> 00:07:43,830
there for a while and actually turn hard

192
00:07:49,070 --> 00:07:45,750
you can actually take a look back

193
00:07:52,100 --> 00:07:49,080
through those layers and understand that

194
00:07:53,930 --> 00:07:52,110
you know the kind of the the different

195
00:07:55,850 --> 00:07:53,940
conditions that were prevalent at the

196
00:07:58,010 --> 00:07:55,860
time that each layer was put down and so

197
00:08:00,200 --> 00:07:58,020
it's the same thing with with mud or

198
00:08:01,340 --> 00:08:00,210
with water you know that that that's

199
00:08:03,140 --> 00:08:01,350
contained and other elements that are

200
00:08:06,170 --> 00:08:03,150
that are prevalent still as you start to

201
00:08:08,810 --> 00:08:06,180
bring up those those mud cores and so we

202
00:08:11,330 --> 00:08:08,820
did a couple of different things when we

203
00:08:14,330 --> 00:08:11,340
would go up to the High Arctic we were

204
00:08:16,130 --> 00:08:14,340
trying to understand the the elements of

205
00:08:18,620 --> 00:08:16,140
change that may or may not have been

206
00:08:20,630 --> 00:08:18,630
present over the last hundred and fifty

207
00:08:22,580 --> 00:08:20,640
years at the time and so we had to look

208
00:08:24,740 --> 00:08:22,590
further back in time to really

209
00:08:26,570 --> 00:08:24,750
characterize what the baseline was of

210
00:08:28,040 --> 00:08:26,580
that environment you know how stable was

211
00:08:30,710 --> 00:08:28,050
it when was it changing that sort of

212
00:08:32,330 --> 00:08:30,720
thing and we used biomarkers called

213
00:08:36,050 --> 00:08:32,340

diatoms which are single-celled algae

214
00:08:37,400 --> 00:08:36,060
and they have a siliceous cell walls and

215
00:08:38,870 --> 00:08:37,410
so we would look at their communities

216
00:08:41,690 --> 00:08:38,880
and how the communities changed over

217
00:08:44,300 --> 00:08:41,700
time and these cores and these you know

218
00:08:46,280 --> 00:08:44,310
sediment cores and we would also try and

219
00:08:48,560 --> 00:08:46,290
calibrate that against what the present

220
00:08:50,540 --> 00:08:48,570
communities were and then examine over

221
00:08:53,450 --> 00:08:50,550
time how that's changed and that would

222
00:08:55,640 --> 00:08:53,460
give an indication of the rate of

223
00:08:57,680 --> 00:08:55,650
change would give the indication of you

224
00:09:01,190 --> 00:08:57,690
know temporally when change occurred and

225
00:09:02,960 --> 00:09:01,200
things like that so as part of that work

226
00:09:05,810 --> 00:09:02,970
I was really fortunate to be able to

227
00:09:09,170 --> 00:09:05,820
visit a number of different higher high

228
00:09:11,810 --> 00:09:09,180
Arctic islands and work with a variety

229
00:09:14,510 --> 00:09:11,820
of different people and through that

230
00:09:17,060 --> 00:09:14,520
work I also got to meet folks like

231
00:09:20,920 --> 00:09:17,070
Charlie cacao Pascal Lee Chris McKay

232
00:09:23,630 --> 00:09:20,930
people who in the High Arctic for

233
00:09:25,490 --> 00:09:23,640
astrobiology reasons as well as because

234
00:09:29,000 --> 00:09:25,500
they were interested in using the High

235
00:09:30,920 --> 00:09:29,010
Arctic as an analog to Mars and so again

236
00:09:32,900 --> 00:09:30,930
you know it put me back to your first

237
00:09:34,940 --> 00:09:32,910
question about how does your life look

238
00:09:36,260 --> 00:09:34,950

it's not linear it certainly isn't I

239
00:09:38,510 --> 00:09:36,270
mean I couldn't have imagined that

240
00:09:41,270 --> 00:09:38,520
taking that course with John small

241
00:09:43,940 --> 00:09:41,280
studying water would have eventually led

242
00:09:45,950 --> 00:09:43,950
me to this other deep you know interest

243
00:09:48,230 --> 00:09:45,960
of mine which was in space exploration

244
00:09:50,290 --> 00:09:48,240
and the people that have since become

245
00:09:52,130 --> 00:09:50,300
very you know influential in my life

246
00:09:53,900 --> 00:09:52,140
that's so cool I had a similar

247
00:09:55,820 --> 00:09:53,910
experience in grad school it was one

248
00:09:57,560 --> 00:09:55,830
class that shunted me in a completely

249
00:09:58,280 --> 00:09:57,570
different direction so I empathize

250
00:09:59,690 --> 00:09:58,290
that's awesome

251
00:10:01,880 --> 00:09:59,700
so it's cool that was you know his

252
00:10:04,730 --> 00:10:01,890
knowledge from chemistry and geology and

253
00:10:08,390 --> 00:10:04,740
biology Mudd goes from muds to the most

254
00:10:10,850 --> 00:10:08,400
exciting thing in the world and and so

255
00:10:13,340 --> 00:10:10,860
that's probably led to you studying the

256
00:10:15,770 --> 00:10:13,350
actually the microbialites so the

257
00:10:18,320 --> 00:10:15,780
structures formed by biology on lakes

258
00:10:22,340 --> 00:10:18,330
eat floors at pavilion Lake Inn and I

259
00:10:24,560 --> 00:10:22,350
think it's in Canada it is and and which

260
00:10:25,340 --> 00:10:24,570
is an incredible project and so I was

261
00:10:27,800 --> 00:10:25,350
wondering if you could tell us a little

262
00:10:30,290 --> 00:10:27,810
bit more of that project and how it is

263
00:10:36,140 --> 00:10:30,300

to dive in these Lakes and witness this

264
00:10:37,040 --> 00:10:36,150
alien world cold it's cold so yeah

265
00:10:38,690 --> 00:10:37,050
thanks for asking

266
00:10:42,230 --> 00:10:38,700
that's that was a really wonderful

267
00:10:44,570 --> 00:10:42,240
project to be a part of so as when I

268
00:10:48,620 --> 00:10:44,580
finished up my graduate work in Canada

269
00:10:51,350 --> 00:10:48,630
at the University of Toronto I then came

270
00:10:54,380 --> 00:10:51,360
down to NASA Ames to join Chris McKay's

271
00:10:56,780 --> 00:10:54,390
group as a postdoc and the first project

272
00:10:58,160 --> 00:10:56,790
that I had to work on was you know Chris

273
00:11:00,320 --> 00:10:58,170
asking me hey there's this lake in

274
00:11:02,810 --> 00:11:00,330
Canada we published one paper describing

275
00:11:04,310 --> 00:11:02,820
some Mike that are growing in there and

276
00:11:06,500 --> 00:11:04,320
what we really want somebody to come in

277
00:11:07,350 --> 00:11:06,510
and and better better characterize this

278
00:11:09,269 --> 00:11:07,360
environment and

279
00:11:10,769 --> 00:11:09,279
you know hey your illuminologists and

280
00:11:12,750 --> 00:11:10,779
hey you're from Canada isn't that funny

281
00:11:14,280 --> 00:11:12,760
so why don't you go up and do that and I

282
00:11:16,170 --> 00:11:14,290
thought well this is this is fantastic

283
00:11:17,850 --> 00:11:16,180
of it you know the the opportunity was

284
00:11:19,970 --> 00:11:17,860
really interesting from a lemma logical

285
00:11:21,900 --> 00:11:19,980
standpoint as well as the connection to

286
00:11:24,750 --> 00:11:21,910
astrobiology and understanding the

287
00:11:26,430 --> 00:11:24,760
development of microbialites in what you

288
00:11:28,290 --> 00:11:26,440

know it but with what was seemingly not

289
00:11:29,940 --> 00:11:28,300
a very extreme environment compared to

290
00:11:32,100 --> 00:11:29,950
other environments that Harbor

291
00:11:34,230 --> 00:11:32,110
microbialites presently which tend to be

292
00:11:37,560 --> 00:11:34,240
high alkalinity how high salinity

293
00:11:39,990 --> 00:11:37,570
environments so the first time I visited

294
00:11:41,310 --> 00:11:40,000
the lake we dove in the lake and we dove

295
00:11:44,310 --> 00:11:41,320
in the lake multiple times thereafter

296
00:11:46,500 --> 00:11:44,320
it's always very cold as soon as you've

297
00:11:49,380 --> 00:11:46,510
hit the thermic line within you know at

298
00:11:50,940 --> 00:11:49,390
about thirty feet or so it starts to the

299
00:11:52,050 --> 00:11:50,950
temperature starts to drop rapidly until

300
00:11:55,530 --> 00:11:52,060
you get to about four degrees Celsius

301
00:11:58,050 --> 00:11:55,540
around I think about 75 feet or so and

302
00:11:59,670 --> 00:11:58,060
then down to the depths of the lake it

303
00:12:02,579 --> 00:11:59,680
remains at that at that temperature

304
00:12:05,730 --> 00:12:02,589
level so it's cold but it's incredibly

305
00:12:07,620 --> 00:12:05,740
beautiful in the lake it's an ultra

306
00:12:09,720 --> 00:12:07,630
oligotrophic lake it's not highly

307
00:12:12,090 --> 00:12:09,730
productive the lake is also groundwater

308
00:12:14,130 --> 00:12:12,100
fed and so it's very clear so the

309
00:12:15,810 --> 00:12:14,140
visibility is actually unlike other

310
00:12:18,449 --> 00:12:15,820
lakes that I've Dovan where you have a

311
00:12:20,100 --> 00:12:18,459
lot of productivity your vision is you

312
00:12:22,290 --> 00:12:20,110
know occluded by the fact that there's

313
00:12:24,389 --> 00:12:22,300

just so much matter that's in whether

314
00:12:26,850 --> 00:12:24,399
it's it's or you know let's do plankton

315
00:12:28,439 --> 00:12:26,860
or plankton or or just you know

316
00:12:30,480 --> 00:12:28,449
sentiment that's been suspended in the

317
00:12:32,610 --> 00:12:30,490
lake it sometimes can be very difficult

318
00:12:37,019 --> 00:12:32,620
to dive in these inland systems but not

319
00:12:38,910 --> 00:12:37,029
in pavilion Lake but so aside from the

320
00:12:42,120 --> 00:12:38,920
fact that that microbe relates

321
00:12:43,769 --> 00:12:42,130
themselves were very diverse in terms of

322
00:12:46,530 --> 00:12:43,779
their morphology their shape their size

323
00:12:49,470 --> 00:12:46,540
and this was pretty unusual find that

324
00:12:51,630 --> 00:12:49,480
sort of diversity in one in one site and

325
00:12:53,130 --> 00:12:51,640
so we wanted to really explore that so

326
00:12:55,590 --> 00:12:53,140
that was number one we wanted to

327
00:12:58,290 --> 00:12:55,600
understand the influence of light on

328
00:13:00,600 --> 00:12:58,300
these shapes and that we were seeing in

329
00:13:03,210 --> 00:13:00,610
the lake but we also wanted to get a

330
00:13:06,300 --> 00:13:03,220
better handle as to what the direct kind

331
00:13:08,400 --> 00:13:06,310
of physical influences were on their

332
00:13:10,079 --> 00:13:08,410
development and whether or not there

333
00:13:11,670 --> 00:13:10,089
were water sources that the

334
00:13:13,800 --> 00:13:11,680
microbialites were associating

335
00:13:15,870 --> 00:13:13,810
themselves with which was one hypothesis

336
00:13:17,250 --> 00:13:15,880
or if in fact they were more diverse

337
00:13:20,519 --> 00:13:17,260
throughout the lake and more widespread

338
00:13:21,240 --> 00:13:20,529

and the lake dropped down to just over

339
00:13:23,100 --> 00:13:21,250
200

340
00:13:25,410 --> 00:13:23,110
10 feet so it's it's fairly deep it's

341
00:13:27,420 --> 00:13:25,420
not super deep by like you know world

342
00:13:29,550 --> 00:13:27,430
standards but deep enough that you

343
00:13:31,500 --> 00:13:29,560
couldn't dive to that level with just

344
00:13:36,330 --> 00:13:31,510
kind of a you know a standard

345
00:13:37,650 --> 00:13:36,340
segregation yeah exactly but and the

346
00:13:39,840 --> 00:13:37,660
other thing about the lake is that it

347
00:13:43,620 --> 00:13:39,850
was six kilometers long and about a

348
00:13:46,980 --> 00:13:43,630
kilometer wide so it's it's a lot of a

349
00:13:48,900 --> 00:13:46,990
lot of Lake to explore so we started

350
00:13:51,990 --> 00:13:48,910
examining other tool sets using our

351
00:13:53,970 --> 00:13:52,000
Ovie's remotely operated vehicles AUV is

352
00:13:56,610 --> 00:13:53,980
autonomous underwater vehicles and then

353
00:13:59,130 --> 00:13:56,620
then we we managed to get a an

354
00:14:00,900 --> 00:13:59,140
opportunity that came up with a company

355
00:14:03,930 --> 00:14:00,910
in Canada called new Co research where

356
00:14:06,020 --> 00:14:03,940
they wanted to partner with us to give

357
00:14:08,760 --> 00:14:06,030
us the single person submersibles that

358
00:14:10,770 --> 00:14:08,770
week yeah that we could put our

359
00:14:12,660 --> 00:14:10,780
scientists into they could be the pilot

360
00:14:15,030 --> 00:14:12,670
in command they could do the mapping

361
00:14:16,590 --> 00:14:15,040
they could do the exploring and do and

362
00:14:19,170 --> 00:14:16,600
basically interact with the environment

363
00:14:20,970 --> 00:14:19,180

safely at the deepest points and

364
00:14:23,130 --> 00:14:20,980
anywhere in the lake those are

365
00:14:25,740 --> 00:14:23,140
submarines which have like a plexiglass

366
00:14:27,960 --> 00:14:25,750
bubble above the pilot right above the

367
00:14:29,700 --> 00:14:27,970
scientist so it's like Alvin for example

368
00:14:31,740 --> 00:14:29,710
wave a window that's like this small you

369
00:14:34,320 --> 00:14:31,750
have your whole ceiling and walls is

370
00:14:36,300 --> 00:14:34,330
see-through how does it feel when you're

371
00:14:42,870 --> 00:14:36,310
in there like like what do you smell

372
00:14:44,700 --> 00:14:42,880
what do you see like goose barks and I

373
00:14:46,320 --> 00:14:44,710
guess so let me tell you a bit about the

374
00:14:49,230 --> 00:14:46,330
philosophy of Phil Newton who built

375
00:14:51,660 --> 00:14:49,240
these submersibles who's the the owner

376
00:14:53,850 --> 00:14:51,670
and founder and operator of Newco so he

377
00:14:56,310 --> 00:14:53,860
wanted to bring the ocean the oceans to

378
00:14:59,730 --> 00:14:56,320
the masses and so his idea was to create

379
00:15:02,880 --> 00:14:59,740
a system whereby you could quickly learn

380
00:15:05,220 --> 00:15:02,890
how to operate it you could feel you

381
00:15:07,590 --> 00:15:05,230
know you could safely operate it without

382
00:15:10,170 --> 00:15:07,600
too much training and you would also

383
00:15:13,170 --> 00:15:10,180
have exactly as you honed in on a very

384
00:15:14,790 --> 00:15:13,180
large I guess you know a really large

385
00:15:16,800 --> 00:15:14,800
field of view so that you could truly

386
00:15:19,470 --> 00:15:16,810
interact with your environment and so he

387
00:15:20,940 --> 00:15:19,480
took a business class airline seat like

388
00:15:23,579 --> 00:15:20,950

an old one you know not some of these

389
00:15:24,780 --> 00:15:23,589
really sexy big giant ones that recline

390
00:15:26,520 --> 00:15:24,790
the whole way but like an old one but

391
00:15:29,010 --> 00:15:26,530
still pretty big stuck it in his

392
00:15:31,560 --> 00:15:29,020
workshop and then built this structure

393
00:15:33,360 --> 00:15:31,570
around it and so it's it's it's pretty

394
00:15:35,190 --> 00:15:33,370
compact when you get in you can't really

395
00:15:37,290 --> 00:15:35,200
see you know the ends of your

396
00:15:39,060 --> 00:15:37,300
of your legs because they're just sort

397
00:15:41,130 --> 00:15:39,070
of jammed into this small space so

398
00:15:44,070 --> 00:15:41,140
certainly not for people that have

399
00:15:46,620 --> 00:15:44,080
issues with confinement but once you're

400
00:15:48,600 --> 00:15:46,630
in and you sort of you know get yourself

401
00:15:50,700 --> 00:15:48,610
comfortable when the bubble does go up

402
00:15:53,580 --> 00:15:50,710
and over your heads you do have a real

403
00:15:57,930 --> 00:15:53,590
sense of I guess immersion in your

404
00:16:00,120 --> 00:15:57,940
environment and so we've piloted those

405
00:16:04,680 --> 00:16:00,130
subs from anywhere from a couple hours

406
00:16:07,770 --> 00:16:04,690
to over six hours at a time and when you

407
00:16:11,250 --> 00:16:07,780
are operating at those steps of 200 feet

408
00:16:12,960 --> 00:16:11,260
and 4 degrees C temperature the the

409
00:16:14,700 --> 00:16:12,970
internal temperature of the submersible

410
00:16:18,180 --> 00:16:14,710
ends up kind of equilibrating with the

411
00:16:20,900 --> 00:16:18,190
outside so it gets very cold inside but

412
00:16:23,250 --> 00:16:20,910
it's amazing because a font upon first

413
00:16:25,560 --> 00:16:23,260

thought of actually being in this space

414
00:16:28,110 --> 00:16:25,570
for six hours most of us were like well

415
00:16:31,350 --> 00:16:28,120
you know that's gonna be a long time but

416
00:16:33,330 --> 00:16:31,360
you end up being so focused on the task

417
00:16:35,070 --> 00:16:33,340
at hand there's so much going on that

418
00:16:36,750 --> 00:16:35,080
you're managing whether it's piloting

419
00:16:38,220 --> 00:16:36,760
through the lake or talking with the

420
00:16:40,700 --> 00:16:38,230
people that you're connected with on the

421
00:16:42,810 --> 00:16:40,710
surface monitoring your life-support

422
00:16:45,660 --> 00:16:42,820
trying to actually make your scientific

423
00:16:49,710 --> 00:16:45,670
observations that the six hours goes by

424
00:16:51,870 --> 00:16:49,720
very quickly and it's it you know you

425
00:16:54,270 --> 00:16:51,880
get hungry and so you end up having

426
00:16:56,940 --> 00:16:54,280
snacks and at there's it's it you just

427
00:16:59,400 --> 00:16:56,950
create this little ecosystem art around

428
00:17:01,020 --> 00:16:59,410
you and it actually ends up being very

429
00:17:04,170 --> 00:17:01,030
manageable to be in there for it for

430
00:17:05,760 --> 00:17:04,180
that time in fact even more fun look

431
00:17:07,050 --> 00:17:05,770
like a fantastic way to spend a workday

432
00:17:09,660 --> 00:17:07,060
right

433
00:17:11,400 --> 00:17:09,670
it's incredible I'd rather be there for

434
00:17:15,569 --> 00:17:11,410
six hours and driving from San Francisco

435
00:17:18,960 --> 00:17:15,579
to LA like for sure down the i-5 so to

436
00:17:20,730 --> 00:17:18,970
switch gears a little bit because so you

437
00:17:22,770 --> 00:17:20,740
are an analog researcher so you go to

438
00:17:24,780 --> 00:17:22,780

planetary analogs to do work but in

439
00:17:27,420 --> 00:17:24,790
addition to just doing science you're

440
00:17:29,280 --> 00:17:27,430
very interested in the human aspect of

441
00:17:31,200 --> 00:17:29,290
it because when you know once humans

442
00:17:32,850 --> 00:17:31,210
will go to explore Mars it will not be

443
00:17:35,640 --> 00:17:32,860
just about the science but how do we

444
00:17:38,580 --> 00:17:35,650
coordinate between scientists and with

445
00:17:39,900 --> 00:17:38,590
Rovers and and robots so it's so

446
00:17:42,030 --> 00:17:39,910
planetary exploration is going to be

447
00:17:43,740 --> 00:17:42,040
just a lot more complicated than doing

448
00:17:45,870 --> 00:17:43,750
science like we do on earth and that's

449
00:17:48,030 --> 00:17:45,880
something you're actively researching on

450
00:17:48,860 --> 00:17:48,040
in fact you RPI of a project called

451
00:17:50,720 --> 00:17:48,870
basalt

452
00:17:52,130 --> 00:17:50,730
because this is a nasa-funded project

453
00:17:54,529 --> 00:17:52,140
it's obviously an acronym that had to

454
00:17:56,539 --> 00:17:54,539
write down to remember it's the biologic

455
00:17:59,060 --> 00:17:56,549
analogue science associated with lava

456
00:18:00,110 --> 00:17:59,070
terrain so it sounds really fascinating

457
00:18:01,760 --> 00:18:00,120
I was wondering if you could tell us a

458
00:18:03,409 --> 00:18:01,770
little bit what an analogue environment

459
00:18:05,299 --> 00:18:03,419
is why it's important to study and how

460
00:18:07,940 --> 00:18:05,309
did you go from just being a scientist

461
00:18:11,659 --> 00:18:07,950
to more interested in the operations of

462
00:18:13,940 --> 00:18:11,669
science well thanks thanks for asking so

463
00:18:15,860 --> 00:18:13,950

the way I define an analogue is that

464
00:18:19,039 --> 00:18:15,870
it's a place on earth that operat offers

465
00:18:22,039 --> 00:18:19,049
us some sort of physical or or

466
00:18:25,250 --> 00:18:22,049
operational approximation of a planetary

467
00:18:27,470 --> 00:18:25,260
destination and so in some cases there

468
00:18:32,450 --> 00:18:27,480
are there are analogs such as Nemo that

469
00:18:36,409 --> 00:18:32,460
work underwater and play is ideal as an

470
00:18:38,060 --> 00:18:36,419
analogue for say you know in space or in

471
00:18:40,669 --> 00:18:38,070
some cases they'll actually wait

472
00:18:44,779 --> 00:18:40,679
themselves so that they mimic the

473
00:18:46,460 --> 00:18:44,789
different sort of I guess

474
00:18:47,930 --> 00:18:46,470
ergonomics you know that you would

475
00:18:49,789 --> 00:18:47,940
experience on the moon and so they can

476
00:18:51,169 --> 00:18:49,799
play with all that underwater so that's

477
00:18:52,580 --> 00:18:51,179
sort of an operational analog there are

478
00:18:55,039 --> 00:18:52,590
scientific analogs where your focus

479
00:18:58,430 --> 00:18:55,049
specifically on for example habitability

480
00:19:00,230 --> 00:18:58,440
and the life in extreme environments and

481
00:19:03,590 --> 00:19:00,240
then there are other analogs that really

482
00:19:05,539 --> 00:19:03,600
bring those to you know aspects together

483
00:19:07,310 --> 00:19:05,549
and you have to select a site very

484
00:19:08,930 --> 00:19:07,320
carefully as well as a team very

485
00:19:11,000 --> 00:19:08,940
carefully that will allow you to really

486
00:19:14,480 --> 00:19:11,010
integrate those two core components so

487
00:19:15,680 --> 00:19:14,490
through my experiences with the hot Mars

488
00:19:17,480 --> 00:19:15,690

project when I was a graduate student

489
00:19:19,250 --> 00:19:17,490
and then building up the pavilion Lake

490
00:19:21,230 --> 00:19:19,260
research project as you mentioned they

491
00:19:23,840 --> 00:19:21,240
got really interested in science

492
00:19:26,419 --> 00:19:23,850
operations the actual how of enabling

493
00:19:28,820 --> 00:19:26,429
science when you do have when you have

494
00:19:31,279 --> 00:19:28,830
human and robotic elements working

495
00:19:33,430 --> 00:19:31,289
together or you know side-by-side or in

496
00:19:37,789 --> 00:19:33,440
advance of each other however it may be

497
00:19:39,080 --> 00:19:37,799
but you know something that that you

498
00:19:41,360 --> 00:19:39,090
said actually kind of struck me a little

499
00:19:42,409 --> 00:19:41,370
earlier on and that it's the science as

500
00:19:44,029 --> 00:19:42,419
you said you know the science will

501
00:19:45,950 --> 00:19:44,039
happen but then what happens when you

502
00:19:49,279 --> 00:19:45,960
actually bring humans into that

503
00:19:51,680 --> 00:19:49,289
environment well in fact it what may

504
00:19:54,710 --> 00:19:51,690
happen is that we make plan for human

505
00:19:56,750 --> 00:19:54,720
missions in the absence of actually

506
00:19:57,950 --> 00:19:56,760
integrating science into that mission

507
00:19:59,990 --> 00:19:57,960
planning from the get-go

508
00:20:02,480 --> 00:20:00,000
and so that's my like kind of keep me up

509
00:20:03,919 --> 00:20:02,490
at night fear is that that will happen

510
00:20:06,799 --> 00:20:03,929
that science will become an afterthought

511
00:20:08,510 --> 00:20:06,809
because frankly sending humans into any

512
00:20:10,669 --> 00:20:08,520
extreme environment whether it's the

513
00:20:13,340 --> 00:20:10,679

Antarctic underwater back to the moon

514
00:20:15,530 --> 00:20:13,350
onwards to Mars there's there's so many

515
00:20:17,480 --> 00:20:15,540
inherent dangers that you know I get it

516
00:20:19,430 --> 00:20:17,490
the the priority has to be on keeping

517
00:20:22,250 --> 00:20:19,440
them alive and safe and all of the stuff

518
00:20:23,810 --> 00:20:22,260
that goes with that but our help is that

519
00:20:25,820 --> 00:20:23,820
if you're going to take the trip all the

520
00:20:27,080 --> 00:20:25,830
way it's Mars or to somewhere even in

521
00:20:29,390 --> 00:20:27,090
between that you're going to have the

522
00:20:32,810 --> 00:20:29,400
chance to do some science and so we are

523
00:20:34,490 --> 00:20:32,820
my job right now as I see it is to try

524
00:20:38,299 --> 00:20:34,500
and enable that infuse Minh

525
00:20:40,700 --> 00:20:38,309
a you know science into the development

526
00:20:42,950 --> 00:20:40,710
of extra vehicular activity tasking

527
00:20:44,570 --> 00:20:42,960
timelines the set up of the Mission

528
00:20:46,610 --> 00:20:44,580
Support Center and how you actually

529
00:20:48,950 --> 00:20:46,620
interact with with those people on earth

530
00:20:51,260 --> 00:20:48,960
when you have others on Mars who are

531
00:20:54,080 --> 00:20:51,270
disconnected not only by space but by

532
00:20:55,850 --> 00:20:54,090
communication latencies so as we move

533
00:20:58,880 --> 00:20:55,860
further and further away from the earth

534
00:21:01,640 --> 00:20:58,890
there are these avoidable communication

535
00:21:02,960 --> 00:21:01,650
lags that will happen between those that

536
00:21:04,250 --> 00:21:02,970
are traveling out into space and those

537
00:21:06,740 --> 00:21:04,260
that remain on earth and that's

538
00:21:08,780 --> 00:21:06,750

something we can never get around but

539
00:21:10,490 --> 00:21:08,790
they will have to contend with and then

540
00:21:13,340 --> 00:21:10,500
how do you make decisions under those

541
00:21:15,230 --> 00:21:13,350
conditions and then what happens when

542
00:21:17,990 --> 00:21:15,240
you have say limited bandwidth for that

543
00:21:21,590 --> 00:21:18,000
closed communication relays and so we're

544
00:21:24,350 --> 00:21:21,600
questioning every aspect of that of

545
00:21:25,880 --> 00:21:24,360
those concepts from a scientific

546
00:21:29,600 --> 00:21:25,890
operations and a scientific standpoint

547
00:21:32,419 --> 00:21:29,610
so if you need to collect samples for

548
00:21:33,860 --> 00:21:32,429
example and high-grade them what are the

549
00:21:35,900 --> 00:21:33,870
tool sets what are the different

550
00:21:38,090 --> 00:21:35,910
requirements that we will have to say

551
00:21:41,000 --> 00:21:38,100
make decisions on which samples are best

552
00:21:42,890 --> 00:21:41,010
or are better than the other ones how do

553
00:21:45,200 --> 00:21:42,900
you actually make that decision in a

554
00:21:46,970 --> 00:21:45,210
timely manner back on earth so that you

555
00:21:49,940 --> 00:21:46,980
can affect those people on Mars who are

556
00:21:51,950 --> 00:21:49,950
5 15 minutes ahead of you in terms of a

557
00:21:53,870 --> 00:21:51,960
timeline and you know they may already

558
00:21:56,240 --> 00:21:53,880
be on to the next task but you somehow

559
00:21:58,070 --> 00:21:56,250
if you see something of importance and

560
00:22:00,799 --> 00:21:58,080
say you're GigaPan an image that you're

561
00:22:02,060 --> 00:22:00,809
suddenly received back on earth or some

562
00:22:03,860 --> 00:22:02,070
sort of spectral data that you've

563
00:22:06,620 --> 00:22:03,870

actually received on earth again from a

564
00:22:08,990 --> 00:22:06,630
handheld Lister better well how do you

565
00:22:10,970 --> 00:22:09,000
actually organize the entire process so

566
00:22:14,150 --> 00:22:10,980
that you can efficiently get a response

567
00:22:16,310 --> 00:22:14,160
out to those on Mars to guide them or

568
00:22:20,509 --> 00:22:16,320
not so there are so many

569
00:22:22,610 --> 00:22:20,519
devil in the detail elements that pop up

570
00:22:24,409 --> 00:22:22,620
as we go about this work and that's what

571
00:22:27,409 --> 00:22:24,419
I'm curious about that's what I'm hoping

572
00:22:29,810 --> 00:22:27,419
to really understand and put back out to

573
00:22:32,210 --> 00:22:29,820
the community for further work as

574
00:22:34,669 --> 00:22:32,220
fascinating so the basalt project takes

575
00:22:37,310 --> 00:22:34,679
place on basalt which is a volcanic rock

576
00:22:40,009 --> 00:22:37,320
and it takes place in Hawaii so when you

577
00:22:41,930 --> 00:22:40,019
do science on these lava rocks you take

578
00:22:44,269 --> 00:22:41,940
you actually simulate the latency in

579
00:22:45,860 --> 00:22:44,279
communication the bandwidth the using

580
00:22:47,360 --> 00:22:45,870
like spacesuit gloves to do the

581
00:22:50,060 --> 00:22:47,370
manipulations of the rocks you include

582
00:22:51,649 --> 00:22:50,070
all that in your in your in the work so

583
00:22:54,680 --> 00:22:51,659
the only thing we don't included those

584
00:22:56,389 --> 00:22:54,690
three things that you offered up was the

585
00:22:58,940 --> 00:22:56,399
spacesuit and the gloves kind of

586
00:23:00,740 --> 00:22:58,950
component so because we're on earth and

587
00:23:03,019 --> 00:23:00,750
we're you know holding to the gravity

588
00:23:04,909 --> 00:23:03,029

here we figured this is it but this is

589
00:23:06,970 --> 00:23:04,919
not the best way to simulate the

590
00:23:09,769 --> 00:23:06,980
encumbrances of wearing a suit that's

591
00:23:13,730 --> 00:23:09,779
our thinking as a team is that that's

592
00:23:15,560 --> 00:23:13,740
better if you know I guess enabled in a

593
00:23:18,590 --> 00:23:15,570
lab setting where you can really play

594
00:23:20,930 --> 00:23:18,600
with the ergonomics of dealing with a

595
00:23:22,879 --> 00:23:20,940
suit and all of those tasking in a

596
00:23:24,169 --> 00:23:22,889
proper way that simulates saves you know

597
00:23:25,850 --> 00:23:24,179
what it's like to be on Mars on the moon

598
00:23:30,049 --> 00:23:25,860
or in deep space what we are interested

599
00:23:33,409 --> 00:23:30,059
in is specifically how science might or

600
00:23:36,999 --> 00:23:33,419
might not affect the current thinking in

601
00:23:40,190 --> 00:23:37,009
terms of mission architecture EPA

602
00:23:41,389 --> 00:23:40,200
operations the instruments the

603
00:23:42,710 --> 00:23:41,399
ergonomics of the instruments the

604
00:23:44,210 --> 00:23:42,720
decision-making all those types I think

605
00:23:45,710 --> 00:23:44,220
so we're when we're out in the field I

606
00:23:47,720 --> 00:23:45,720
guess the number one thing that we start

607
00:23:50,419 --> 00:23:47,730
with is the science has to drive

608
00:23:52,490 --> 00:23:50,429
everything so we get our funding

609
00:23:55,460 --> 00:23:52,500
primarily through a science Mission

610
00:23:57,560 --> 00:23:55,470
Directorate at NASA and so we eyes are

611
00:24:01,039 --> 00:23:57,570
deliverable we have to put out you know

612
00:24:02,810 --> 00:24:01,049
solid scientific output and and research

613
00:24:05,690 --> 00:24:02,820

output in peer review publications

614
00:24:07,580 --> 00:24:05,700
that's a that's an absolute and as a

615
00:24:10,519 --> 00:24:07,590
consequence of that we have to drive at

616
00:24:13,490 --> 00:24:10,529
every point with with that in mind and

617
00:24:16,009 --> 00:24:13,500
of course I'm a scientist I'm interested

618
00:24:17,930 --> 00:24:16,019
specifically in the element of how

619
00:24:20,570 --> 00:24:17,940
science affects these types of

620
00:24:23,119 --> 00:24:20,580
operations and so we have a science team

621
00:24:24,680 --> 00:24:23,129
that you know puts together a science

622
00:24:27,590 --> 00:24:24,690
traceability matrix we start with that

623
00:24:29,180 --> 00:24:27,600
and we check ourselves against that you

624
00:24:30,019 --> 00:24:29,190
know before we head into a mission

625
00:24:31,459 --> 00:24:30,029
planning stage

626
00:24:33,379 --> 00:24:31,469
while we're in the mission after the

627
00:24:36,200 --> 00:24:33,389
mission and that guides everything and

628
00:24:38,330 --> 00:24:36,210
the little twist to our science is that

629
00:24:40,940 --> 00:24:38,340
we do all of our fieldwork under

630
00:24:43,249 --> 00:24:40,950
simulated Mars mission conditions so

631
00:24:46,310 --> 00:24:43,259
what that means is that we don't get you

632
00:24:49,249 --> 00:24:46,320
know the forty person science team out

633
00:24:51,259 --> 00:24:49,259
in the field they have to sit separate

634
00:24:54,769 --> 00:24:51,269
from the science team that's the field

635
00:24:57,139 --> 00:24:54,779
team in a control center in Mission

636
00:24:59,119 --> 00:24:57,149
Support Center and then there's only two

637
00:25:01,159 --> 00:24:59,129
people that go out effectively as like

638
00:25:02,659 --> 00:25:01,169

Mars astronauts out into the field and

639
00:25:04,489 --> 00:25:02,669
they've been trained but they're not the

640
00:25:07,070 --> 00:25:04,499
world's experts on say you know

641
00:25:08,869 --> 00:25:07,080
alteration products associated with

642
00:25:10,759 --> 00:25:08,879
basalts that person's sitting back on

643
00:25:14,089 --> 00:25:10,769
back on earth in the Mission Support

644
00:25:16,820 --> 00:25:14,099
Center and have generated very

645
00:25:18,379 --> 00:25:16,830
systematically a list of requirements in

646
00:25:20,060 --> 00:25:18,389
terms of what type of data the

647
00:25:22,009 --> 00:25:20,070
scientists would like to see transmitted

648
00:25:25,789 --> 00:25:22,019
transmitted from the field back to them

649
00:25:28,849 --> 00:25:25,799
and and then built our mission around

650
00:25:30,669 --> 00:25:28,859
those requirements so the astronauts for

651
00:25:34,249 --> 00:25:30,679
example are they're transmitting voice

652
00:25:35,989 --> 00:25:34,259
video through three different means they

653
00:25:38,839 --> 00:25:35,999
have spectral data that comes back to

654
00:25:43,609 --> 00:25:38,849
the science team they also have

655
00:25:46,369 --> 00:25:43,619
telemetry and and and other imaging data

656
00:25:50,209 --> 00:25:46,379
sources and so we aggregate those

657
00:25:51,889 --> 00:25:50,219
different data products and allow the

658
00:25:53,570 --> 00:25:51,899
science team to interact with them in a

659
00:25:55,219 --> 00:25:53,580
very kind of methodical way and we have

660
00:25:57,019 --> 00:25:55,229
an entire group that builds up the

661
00:26:01,070 --> 00:25:57,029
software capabilities to enable that and

662
00:26:02,599 --> 00:26:01,080
then any thoughts that either group has

663
00:26:04,219 --> 00:26:02,609

that meets that they need to transmit

664
00:26:07,249 --> 00:26:04,229
back and forth is actually done as you

665
00:26:09,200 --> 00:26:07,259
mentioned under latency so we inject a

666
00:26:11,180 --> 00:26:09,210
five-minute and a 15-minute one-way

667
00:26:13,099 --> 00:26:11,190
latency in in very strict test

668
00:26:16,759 --> 00:26:13,109
conditions and then we also reduce the

669
00:26:18,680 --> 00:26:16,769
bandwidth you know down to what are

670
00:26:22,190 --> 00:26:18,690
estimated to be probably you know pretty

671
00:26:23,479 --> 00:26:22,200
solid transmission levels when you have

672
00:26:24,709 --> 00:26:23,489
low bandwidth versus high bandwidth

673
00:26:26,989 --> 00:26:24,719
conditions between the Earth and Mars

674
00:26:29,869 --> 00:26:26,999
and and so we try and look at the

675
00:26:32,180 --> 00:26:29,879
effects of all those conditions on the

676
00:26:34,399 --> 00:26:32,190
operations as we have them scoped out

677
00:26:36,619 --> 00:26:34,409
there so what have you found does it

678
00:26:38,239 --> 00:26:36,629
work like are we able to do science in

679
00:26:40,219 --> 00:26:38,249
such environments are the challenges

680
00:26:42,840 --> 00:26:40,229
that we need to still solve to explore

681
00:26:44,310 --> 00:26:42,850
Mars or other systems properly

682
00:26:46,110 --> 00:26:44,320
yeah that's a great question so two

683
00:26:48,539 --> 00:26:46,120
things first of all look for more

684
00:26:51,149 --> 00:26:48,549
details in the new year we have a

685
00:26:53,039 --> 00:26:51,159
special issue that we're planning for in

686
00:26:55,169 --> 00:26:53,049
astrobiology and we're hoping to have

687
00:26:56,460 --> 00:26:55,179
most of the papers submitted by the end

688
00:27:00,090 --> 00:26:56,470

of this year or the beginning of next

689
00:27:02,580 --> 00:27:00,100
and so we'll have tails for you in that

690
00:27:06,509 --> 00:27:02,590
realm but to answer broadly in terms of

691
00:27:08,580 --> 00:27:06,519
what we found is that under so-so if you

692
00:27:09,930 --> 00:27:08,590
ask scientists right now what do you

693
00:27:12,180 --> 00:27:09,940
want transmitted from the field

694
00:27:14,340 --> 00:27:12,190
especially if you can't be out there a

695
00:27:16,470 --> 00:27:14,350
lot of them will say as much as you can

696
00:27:18,419 --> 00:27:16,480
give me because I'm not there and so

697
00:27:20,639 --> 00:27:18,429
it's sort of nerve-wracking

698
00:27:23,159 --> 00:27:20,649
but but that's an impossibility you

699
00:27:25,139 --> 00:27:23,169
can't have every bit of data stream back

700
00:27:26,970 --> 00:27:25,149
and so one of the thoughts was that

701
00:27:30,149 --> 00:27:26,980
video was going to be very important to

702
00:27:33,330 --> 00:27:30,159
the scientists because it was thought of

703
00:27:35,669 --> 00:27:33,340
as you know sort of a mechanism for them

704
00:27:37,769 --> 00:27:35,679
to live in the moment to really feel

705
00:27:39,419 --> 00:27:37,779
immersed in the environment but as it

706
00:27:41,999 --> 00:27:39,429
turns out in fact there's still high

707
00:27:43,560 --> 00:27:42,009
resolution still images and we're going

708
00:27:45,210 --> 00:27:43,570
to play a little bit with GigaPan images

709
00:27:48,090 --> 00:27:45,220
in this forthcoming deployment are

710
00:27:49,649 --> 00:27:48,100
likely much more important to the

711
00:27:52,110 --> 00:27:49,659
scientists lives as we see through

712
00:27:53,730 --> 00:27:52,120
robotic missions in terms of

713
00:27:56,360 --> 00:27:53,740

understanding the environment and being

714
00:27:58,590 --> 00:27:56,370
able to make decisions on which which

715
00:28:01,730 --> 00:27:58,600
samples are better to collect versus the

716
00:28:04,080 --> 00:28:01,740
other and so that's in terms of

717
00:28:07,409 --> 00:28:04,090
generating requirements and trying to

718
00:28:09,659 --> 00:28:07,419
figure out what types of imaging systems

719
00:28:13,379 --> 00:28:09,669
what type of spectral data for example

720
00:28:15,360 --> 00:28:13,389
is beneficial under when trying to

721
00:28:17,220 --> 00:28:15,370
actually ascertain certain you know bits

722
00:28:19,369 --> 00:28:17,230
of information that's what we're sort of

723
00:28:22,369 --> 00:28:19,379
walking through right now and trying to

724
00:28:25,320 --> 00:28:22,379
to really get a handle on and so

725
00:28:27,690 --> 00:28:25,330
surprisingly video while it has utility

726
00:28:29,519 --> 00:28:27,700
it's actually not as useful as you would

727
00:28:32,730 --> 00:28:29,529
think and so these and resolution still

728
00:28:34,139 --> 00:28:32,740
images have a great deal of benefit

729
00:28:37,019 --> 00:28:34,149
especially under low bandwidth

730
00:28:38,580 --> 00:28:37,029
conditions and so there's there's that

731
00:28:40,259 --> 00:28:38,590
there's also other instrument

732
00:28:41,789 --> 00:28:40,269
capabilities that we've been evaluating

733
00:28:43,440 --> 00:28:41,799
that we'll talk about in some of these

734
00:28:45,749 --> 00:28:43,450
special issues and papers that are going

735
00:28:47,549 --> 00:28:45,759
to come out that's fascinating

736
00:28:49,139 --> 00:28:47,559
I'm gonna ask one more question to you

737
00:28:50,730 --> 00:28:49,149
before I open up open it up to the

738
00:28:53,310 --> 00:28:50,740

public again if you're watching live

739
00:28:55,799 --> 00:28:53,320
please use hashtag ask a strobe eye on

740
00:28:55,980 --> 00:28:55,809
Twitter to ask darling a question or you

741
00:28:58,950 --> 00:28:55,990
can

742
00:29:00,930 --> 00:28:58,960
user singing a chat on Sagan org to do

743
00:29:03,330 --> 00:29:00,940
that so my last question to you because

744
00:29:05,100 --> 00:29:03,340
I could chat forever about these cool

745
00:29:07,110 --> 00:29:05,110
topics is what is the coolest place

746
00:29:12,630 --> 00:29:07,120
you've been to as a scientist and what

747
00:29:14,549 --> 00:29:12,640
was it like okay so I know it's super

748
00:29:19,710 --> 00:29:14,559
cliche but I'm gonna have to pick the

749
00:29:20,970 --> 00:29:19,720
Antarctic chart that's so cool yeah I

750
00:29:22,710 --> 00:29:20,980
have been I've been you know really

751
00:29:25,080 --> 00:29:22,720
fortunate to see a number of places I

752
00:29:26,190 --> 00:29:25,090
mean I think it's that question it's for

753
00:29:27,720 --> 00:29:26,200
me it's kind of like picking a favorite

754
00:29:30,230 --> 00:29:27,730
child

755
00:29:34,200 --> 00:29:30,240
you know you can't because every

756
00:29:35,880 --> 00:29:34,210
everywhere has its beauty and the

757
00:29:37,169 --> 00:29:35,890
challenges that come with being immersed

758
00:29:41,730 --> 00:29:37,179
in these different environments as well

759
00:29:43,350 --> 00:29:41,740
is it's very deeply affecting but I can

760
00:29:46,320 --> 00:29:43,360
tell you that the Antarctic is is

761
00:29:48,360 --> 00:29:46,330
completely otherworldly and unlike

762
00:29:50,070 --> 00:29:48,370
anything I had been prepared to see and

763
00:29:53,430 --> 00:29:50,080

I was very fortunate to go to the

764
00:29:55,260 --> 00:29:53,440
Antarctic I think it was in 2001 with

765
00:29:59,220 --> 00:29:55,270
the u.s. United States Antarctic

766
00:30:01,760 --> 00:29:59,230
training program and so that's certainly

767
00:30:05,640 --> 00:30:01,770
top of my list but you know seeing

768
00:30:08,400 --> 00:30:05,650
Kilauea at night in the morning

769
00:30:10,049 --> 00:30:08,410
being in the depths of pavilion Lake the

770
00:30:12,740 --> 00:30:10,059
High Arctic all the experiences that

771
00:30:15,120 --> 00:30:12,750
I've had they're just small and big and

772
00:30:16,560 --> 00:30:15,130
there's those sit with me certainly and

773
00:30:18,660 --> 00:30:16,570
I think the other thing is aside from

774
00:30:20,580 --> 00:30:18,670
just the physical nature of each

775
00:30:23,010 --> 00:30:20,590
environment what I'm left with is I

776
00:30:26,910 --> 00:30:23,020
think back are the experiences I've had

777
00:30:28,950 --> 00:30:26,920
with people and that's I think also been

778
00:30:31,200 --> 00:30:28,960
impactful in terms of the way that I've

779
00:30:33,840 --> 00:30:31,210
marched for it in my career and that I'm

780
00:30:36,620 --> 00:30:33,850
hopeful that in small in some small way

781
00:30:40,230 --> 00:30:36,630
you know that we'll be able to help

782
00:30:42,540 --> 00:30:40,240
humanity retain or will help retain the

783
00:30:44,310 --> 00:30:42,550
humanity and human exploration as we

784
00:30:46,590 --> 00:30:44,320
move ahead so we're going to need all

785
00:30:48,930 --> 00:30:46,600
these procedures all these operational

786
00:30:52,200 --> 00:30:48,940
constraints will be imposed on us but I

787
00:30:53,790 --> 00:30:52,210
want to make sure that the experience of

788
00:30:55,200 --> 00:30:53,800

being a human in these extreme

789
00:30:57,660 --> 00:30:55,210
environments and the interactions that

790
00:31:00,210 --> 00:30:57,670
we want to have with other human beings

791
00:31:02,100 --> 00:31:00,220
in those environments somehow enabled

792
00:31:03,480 --> 00:31:02,110
despite all of the hardware and software

793
00:31:06,299 --> 00:31:03,490
and everything else that we're going to

794
00:31:08,340 --> 00:31:06,309
have in our lives because that is where

795
00:31:09,390 --> 00:31:08,350
you get some really great innovations or

796
00:31:11,510 --> 00:31:09,400
the station

797
00:31:13,500 --> 00:31:11,520
you have with your colleagues when you

798
00:31:15,900 --> 00:31:13,510
realize that you have a lot in common

799
00:31:17,700 --> 00:31:15,910
that you want to solve problems by kind

800
00:31:19,470 --> 00:31:17,710
of dropping your obfuscation z' at the

801
00:31:22,200 --> 00:31:19,480
door and your ego at the door and you

802
00:31:24,630 --> 00:31:22,210
just want to you know kind of talk

803
00:31:26,970 --> 00:31:24,640
across and talk together and and it's

804
00:31:30,570 --> 00:31:26,980
those are really wonderful moments that

805
00:31:32,430 --> 00:31:30,580
to me have you know lasted in my psyche

806
00:31:34,800 --> 00:31:32,440
from each and every field outing that

807
00:31:36,680 --> 00:31:34,810
I've had that's that's wonderful yeah

808
00:31:39,120 --> 00:31:36,690
science is a very intercultural

809
00:31:40,740 --> 00:31:39,130
experience and profession which is great

810
00:31:43,080 --> 00:31:40,750
I was reading on the pavilion Laker

811
00:31:45,060 --> 00:31:43,090
website that yet scientists for fifteen

812
00:31:46,980 --> 00:31:45,070
different nationalities that came and

813
00:31:48,000 --> 00:31:46,990

worked with you on the on project so in

814
00:31:49,560 --> 00:31:48,010
history it's just really cool

815
00:31:51,150 --> 00:31:49,570
environment in evening around the

816
00:31:53,370 --> 00:31:51,160
campfire discussing science but also

817
00:31:54,360 --> 00:31:53,380
different perspectives and new ideas

818
00:31:56,040 --> 00:31:54,370
coming from different cultural

819
00:31:58,410 --> 00:31:56,050
backgrounds to innovate on a particular

820
00:31:59,880 --> 00:31:58,420
topic so that's fantastic so thanks for

821
00:32:02,970 --> 00:31:59,890
sharing that I'm going to put it up to

822
00:32:04,740 --> 00:32:02,980
questions now so again use hashtag ask

823
00:32:07,320 --> 00:32:04,750
Esther bio to ask us questions for

824
00:32:08,670 --> 00:32:07,330
Darlene and if you aren't saying org use

825
00:32:11,850 --> 00:32:08,680
their chat room so the first questions

826
00:32:14,940 --> 00:32:11,860
from Mark Williamson and he's asking

827
00:32:15,600 --> 00:32:14,950
about between undergraduate and grad

828
00:32:18,000 --> 00:32:15,610
school

829
00:32:19,440 --> 00:32:18,010
some people like take time to either

830
00:32:22,470 --> 00:32:19,450
travel but he's asking particular in

831
00:32:23,820 --> 00:32:22,480
terms of getting a work experience and

832
00:32:27,860 --> 00:32:23,830
in that gap year do you have any

833
00:32:29,820 --> 00:32:27,870
insights on that yeah I mean I can only

834
00:32:32,670 --> 00:32:29,830
okay I can tell you a bit about what I

835
00:32:35,760 --> 00:32:32,680
what I did and then I can give you some

836
00:32:37,470 --> 00:32:35,770
thoughts so what I did is I actually got

837
00:32:39,330 --> 00:32:37,480
a job working in the field of

838
00:32:44,040 --> 00:32:39,340

advertising if you can believe it very

839
00:32:48,120 --> 00:32:44,050
long story it involves wine as free wine

840
00:32:51,030 --> 00:32:48,130
I put it at that and I dare and so I got

841
00:32:52,890 --> 00:32:51,040
a job to work at an advertising firm and

842
00:32:58,410 --> 00:32:52,900
I also was admitted to graduate school

843
00:32:59,910 --> 00:32:58,420
after college and my supervisor who or

844
00:33:01,350 --> 00:32:59,920
the person who became my supervisor for

845
00:33:02,490 --> 00:33:01,360
my graduate work I went to him and I was

846
00:33:04,200 --> 00:33:02,500
like hey I got this other job it's

847
00:33:05,970 --> 00:33:04,210
totally unrelated to science what should

848
00:33:08,430 --> 00:33:05,980
I do and so he actually gave me the best

849
00:33:10,980 --> 00:33:08,440
advice ever he said look it just go do

850
00:33:13,200 --> 00:33:10,990
that for a couple of years but only do

851
00:33:14,760 --> 00:33:13,210
it for two years and then evaluate what

852
00:33:16,500 --> 00:33:14,770
you want out of life at that point if

853
00:33:18,090 --> 00:33:16,510
you really want to come back to science

854
00:33:19,950 --> 00:33:18,100
then then that's when to do it because

855
00:33:22,720 --> 00:33:19,960
if you stay in that field any longer

856
00:33:24,100 --> 00:33:22,730
you'll probably not leave and so I did

857
00:33:25,900 --> 00:33:24,110
that and when I found at the end of my

858
00:33:27,430 --> 00:33:25,910
two years in fact very rapidly is that I

859
00:33:28,900 --> 00:33:27,440
was still reading science papers I was

860
00:33:30,100 --> 00:33:28,910
still talking with my friends who

861
00:33:31,750 --> 00:33:30,110
actually went to graduate school to see

862
00:33:33,880 --> 00:33:31,760
what they were up to so obviously that's

863
00:33:37,000 --> 00:33:33,890

what I wanted to do so I left pretty

864
00:33:38,950 --> 00:33:37,010
solidly paying job and went back to grad

865
00:33:40,630 --> 00:33:38,960
school and then I was in it you know

866
00:33:43,900 --> 00:33:40,640
like I was just like committed and I was

867
00:33:45,430 --> 00:33:43,910
there because I wanted to be and you

868
00:33:47,230 --> 00:33:45,440
know you don't go to grad school and

869
00:33:49,570 --> 00:33:47,240
take up academics for the money

870
00:33:55,240 --> 00:33:49,580
necessarily at least not in this area of

871
00:33:58,150 --> 00:33:55,250
science no I'm not gonna discover you

872
00:34:01,570 --> 00:33:58,160
know goals or anything of any value but

873
00:34:03,909 --> 00:34:01,580
you're in it for the love knowledge so

874
00:34:06,310 --> 00:34:03,919
so that's just my little anecdote but I

875
00:34:09,750 --> 00:34:06,320
think in this day and age what's getting

876
00:34:13,330 --> 00:34:09,760
valued more and more is the ability to

877
00:34:15,700 --> 00:34:13,340
you know it's good to know a topic very

878
00:34:17,260 --> 00:34:15,710
well but I think it's also important to

879
00:34:19,450 --> 00:34:17,270
be able to know a variety of different

880
00:34:22,930 --> 00:34:19,460
topics so that a person can eventually

881
00:34:26,919 --> 00:34:22,940
integrate ideas and identify where there

882
00:34:30,099 --> 00:34:26,929
is a new and innovative pathway to

883
00:34:31,659 --> 00:34:30,109
solving a problem because you're going

884
00:34:34,359 --> 00:34:31,669
to need people that can actually look

885
00:34:35,859 --> 00:34:34,369
across disciplines as well as integrate

886
00:34:37,930 --> 00:34:35,869
and aggregate those disciplines in a

887
00:34:39,280 --> 00:34:37,940
manner that solves problems from a

888
00:34:42,250 --> 00:34:39,290

variety different perspectives and so I

889
00:34:44,619 --> 00:34:42,260
think getting knowledge like you know

890
00:34:46,990 --> 00:34:44,629
from from working and experiencing or

891
00:34:49,389 --> 00:34:47,000
volunteering outside of your sort of

892
00:34:51,669 --> 00:34:49,399
comfort area if you will is always

893
00:34:54,129 --> 00:34:51,679
valuable and you'll also discover I

894
00:34:55,810 --> 00:34:54,139
think maybe you know what you don't like

895
00:34:57,280 --> 00:34:55,820
to do which is always a good thing to

896
00:34:59,170 --> 00:34:57,290
find out to help you figure out what you

897
00:35:01,230 --> 00:34:59,180
do want to do and you might also find

898
00:35:04,000 --> 00:35:01,240
along the way things that immediately

899
00:35:05,770 --> 00:35:04,010
kind of pop up and just get you so

900
00:35:07,330 --> 00:35:05,780
excited and that may be because you meet

901
00:35:08,950 --> 00:35:07,340
the right professor you meet the right

902
00:35:10,930 --> 00:35:08,960
person or you just read something that

903
00:35:12,970 --> 00:35:10,940
completely resonates with with who you

904
00:35:16,210 --> 00:35:12,980
are and where you see yourself in the

905
00:35:18,910 --> 00:35:16,220
coming years so you know for me I I

906
00:35:20,620 --> 00:35:18,920
encourage exploration of all nature's

907
00:35:22,330 --> 00:35:20,630
because I think that's what makes you

908
00:35:25,150 --> 00:35:22,340
that much better of an explorer in

909
00:35:27,250 --> 00:35:25,160
general cool thanks for that yeah mark

910
00:35:29,050 --> 00:35:27,260
to add to that I would also you know

911
00:35:31,660 --> 00:35:29,060
just email people and see if they have

912
00:35:32,590 --> 00:35:31,670
opportunities you just never know if you

913
00:35:35,380 --> 00:35:32,600

had the right time at the right place

914
00:35:38,290 --> 00:35:35,390
they might have an opportunity for you

915
00:35:41,350 --> 00:35:38,300
so but yeah one year is this issue yeah

916
00:35:44,500 --> 00:35:41,360
can I add to that too so Zeena Cartman

917
00:35:47,920 --> 00:35:44,510
is a person that just became just was

918
00:35:51,490 --> 00:35:47,930
selected into the recent astronaut class

919
00:35:55,090 --> 00:35:51,500
and Xena did just that you know saan joy

920
00:35:56,740 --> 00:35:55,100
because she was think an undergrad she

921
00:35:58,120 --> 00:35:56,750
was 19 years old she started emailing a

922
00:36:00,130 --> 00:35:58,130
bunch of people because she knew she

923
00:36:00,970 --> 00:36:00,140
wanted to get to the Antarctic she

924
00:36:04,210 --> 00:36:00,980
wanted to do

925
00:36:06,430 --> 00:36:04,220
astrobiology work and so eventually she

926
00:36:08,020 --> 00:36:06,440
ended up coming to work with with us at

927
00:36:10,540 --> 00:36:08,030
pavilion Lake and then a bunch of other

928
00:36:12,460 --> 00:36:10,550
teams as well but that got her the

929
00:36:13,600 --> 00:36:12,470
experience that she needed to eventually

930
00:36:16,090 --> 00:36:13,610
go to graduate school and then of course

931
00:36:18,640 --> 00:36:16,100
now she's on on the road to becoming an

932
00:36:21,730 --> 00:36:18,650
astronaut as well so I couldn't agree

933
00:36:23,110 --> 00:36:21,740
more that's grated in fact the student

934
00:36:25,690 --> 00:36:23,120
that's working with me that just that

935
00:36:27,550 --> 00:36:25,700
kind of cold emailed me but you know her

936
00:36:29,200 --> 00:36:27,560
timeline what she wanted and I turned I

937
00:36:30,610 --> 00:36:29,210
was just actually looking for a person

938
00:36:31,900 --> 00:36:30,620

to work on a particular project so it

939
00:36:33,490 --> 00:36:31,910
turned out great so you got nothing to

940
00:36:36,670 --> 00:36:33,500
lose the worst they can say is no mark

941
00:36:40,450 --> 00:36:36,680
so go for it so there's a question on

942
00:36:42,730 --> 00:36:40,460
Twitter from at DK 3cw and this person

943
00:36:44,710 --> 00:36:42,740
asks thank you for the question how do I

944
00:36:49,090 --> 00:36:44,720
focus on astrobiology while being an

945
00:36:51,070 --> 00:36:49,100
undergraduate student so it kind of

946
00:36:55,210 --> 00:36:51,080
depends where you're located I guess

947
00:36:58,980 --> 00:36:55,220
now there are I think umbrellas of you

948
00:37:03,280 --> 00:36:58,990
know within universities that offer up

949
00:37:04,750 --> 00:37:03,290
say courses in a I want to say a more

950
00:37:06,970 --> 00:37:04,760
organized fashion so that you get a

951
00:37:08,920 --> 00:37:06,980
breadth of knowledge scientifically that

952
00:37:10,870 --> 00:37:08,930
will serve you well when you actually

953
00:37:12,100 --> 00:37:10,880
move ahead and start to focus down or

954
00:37:14,860 --> 00:37:12,110
whatever idea it is that you want to go

955
00:37:17,440 --> 00:37:14,870
after and so it depends what university

956
00:37:19,600 --> 00:37:17,450
you're at but I think taking a breadth

957
00:37:21,280 --> 00:37:19,610
of Sciences so if you get chance to take

958
00:37:22,720 --> 00:37:21,290
electives outside of whatever core

959
00:37:25,660 --> 00:37:22,730
discipline you're in that's always very

960
00:37:26,950 --> 00:37:25,670
useful I think reading papers in the

961
00:37:28,840 --> 00:37:26,960
city if you just want to pick well I'll

962
00:37:31,750 --> 00:37:28,850
just pick up astrobiology for example it

963
00:37:33,700 --> 00:37:31,760

really you know spans a whole lot of

964
00:37:35,560 --> 00:37:33,710
different topics and you get some pretty

965
00:37:36,850 --> 00:37:35,570
impactful papers that getting published

966
00:37:38,770 --> 00:37:36,860
in that journal as well as many others

967
00:37:41,140 --> 00:37:38,780
are there out there so I think read as

968
00:37:43,480 --> 00:37:41,150
much as you can you know there's nothing

969
00:37:45,280 --> 00:37:43,490
really shameful and reading any anything

970
00:37:47,170 --> 00:37:45,290
for that matter that has to do with with

971
00:37:49,030 --> 00:37:47,180
science or anything else of that nature

972
00:37:49,240 --> 00:37:49,040
you'll you'll get ideas I think even

973
00:37:51,520 --> 00:37:49,250
from

974
00:37:54,910 --> 00:37:51,530
like you know technology magazines and

975
00:37:56,350 --> 00:37:54,920
things like that so I think again it

976
00:37:58,320 --> 00:37:56,360
really depends where where you're at

977
00:38:01,270 --> 00:37:58,330
school what country are in and so forth

978
00:38:02,770 --> 00:38:01,280
yeah there's not a single way to become

979
00:38:05,110 --> 00:38:02,780
an astrobiologist right people were a

980
00:38:06,490 --> 00:38:05,120
geology undergrad become astrobiologists

981
00:38:07,840 --> 00:38:06,500
people was an engineering undergrad

982
00:38:09,180 --> 00:38:07,850
become master biologist people was a

983
00:38:11,020 --> 00:38:09,190
biology undergrad and become

984
00:38:13,030 --> 00:38:11,030
astrobiology I don't think there's a

985
00:38:15,010 --> 00:38:13,040
there's a two identical astrobiologists

986
00:38:17,230 --> 00:38:15,020
right that's the beauty of the designed

987
00:38:19,590 --> 00:38:17,240
of all come together and just this it's

988
00:38:23,680 --> 00:38:19,600

this fantastic hodgepodge of science

989
00:38:25,540 --> 00:38:23,690
yeah yeah exactly and I think I'm asking

990
00:38:27,100 --> 00:38:25,550
some of your professors as well in terms

991
00:38:28,630 --> 00:38:27,110
of what they think if they're involved

992
00:38:31,060 --> 00:38:28,640
with you know any field that sort of

993
00:38:32,350 --> 00:38:31,070
related to astrobiology or even maybe

994
00:38:33,730 --> 00:38:32,360
they're you have a professor that once

995
00:38:35,080 --> 00:38:33,740
again is that feel them would like to

996
00:38:37,480 --> 00:38:35,090
kind of progress on that journey with

997
00:38:39,640 --> 00:38:37,490
you it's always you can always ask them

998
00:38:42,460 --> 00:38:39,650
for assistance and picking your courses

999
00:38:43,810 --> 00:38:42,470
and so forth yeah I should backtrack on

1000
00:38:45,340 --> 00:38:43,820
my use of hodgepodge because I don't

1001
00:38:46,270 --> 00:38:45,350
want to seem that it's it's it's a broad

1002
00:38:48,700 --> 00:38:46,280
science that doesn't have like a

1003
00:38:50,530 --> 00:38:48,710
discipline or a particular topic the

1004
00:38:52,750 --> 00:38:50,540
scientific questions ask an astrobiology

1005
00:38:54,370 --> 00:38:52,760
a very precise but they just come from a

1006
00:38:55,890 --> 00:38:54,380
broad perspective so that's what I meant

1007
00:38:58,300 --> 00:38:55,900
by hodgepodge sorry if I was confusing

1008
00:39:01,150 --> 00:38:58,310
the next question is from penny Boston

1009
00:39:03,160 --> 00:39:01,160
who asks I think the question if you

1010
00:39:06,850 --> 00:39:03,170
could have no constraints on power or

1011
00:39:09,340 --> 00:39:06,860
money and no pressure what is your dream

1012
00:39:11,980 --> 00:39:09,350
instrument or instrument package to use

1013
00:39:15,240 --> 00:39:11,990

for use on earth and potentially on

1014
00:39:20,620 --> 00:39:15,250
space missions to Mars or an icy world

1015
00:39:22,420 --> 00:39:20,630
oh my goodness okay so I'll just okay so

1016
00:39:24,280 --> 00:39:22,430
penny I'll totally answer this strictly

1017
00:39:26,200 --> 00:39:24,290
from a human standpoint cuz that's my

1018
00:39:31,030 --> 00:39:26,210
interest at this point in time I would

1019
00:39:34,120 --> 00:39:31,040
love a geological tricorder and so I

1020
00:39:38,100 --> 00:39:34,130
would love for the tricorder to be to

1021
00:39:41,200 --> 00:39:38,110
that not only could we you know decipher

1022
00:39:43,270 --> 00:39:41,210
the the kind of characteristics

1023
00:39:46,710 --> 00:39:43,280
characteristics of the rock from say the

1024
00:39:51,550 --> 00:39:49,900
understand its temperature I don't know

1025
00:39:53,770 --> 00:39:51,560
you know like it's it's angularity its

1026
00:39:56,650 --> 00:39:53,780
density all that all in one quick little

1027
00:39:58,960 --> 00:39:56,660
press of the button but then i'd love to

1028
00:40:01,180 --> 00:39:58,970
be able to tune it so that say if i

1029
00:40:02,589 --> 00:40:01,190
wanted to compare it to other things

1030
00:40:04,269 --> 00:40:02,599
that i've seen earlier it can

1031
00:40:06,670 --> 00:40:04,279
rapidly tell me where it falls and that

1032
00:40:07,809 --> 00:40:06,680
gradient of rocks that have analyzed so

1033
00:40:10,779 --> 00:40:07,819
something I can high grade really

1034
00:40:12,759 --> 00:40:10,789
quickly and so that's that's totally

1035
00:40:16,269 --> 00:40:12,769
when I'm fixated on right now I want

1036
00:40:18,460 --> 00:40:16,279
that oh and I would love to have a buddy

1037
00:40:21,759 --> 00:40:18,470
like a robotic buddy whether that was

1038
00:40:23,259 --> 00:40:21,769

something that flew or I don't even know

1039
00:40:24,700 --> 00:40:23,269
what it would necessarily look like I

1040
00:40:26,650 --> 00:40:24,710
don't even want to get there but

1041
00:40:28,150 --> 00:40:26,660
something that I could utilize to

1042
00:40:30,069 --> 00:40:28,160
actually get better situational

1043
00:40:33,400 --> 00:40:30,079
awareness of what is around me when I'm

1044
00:40:36,489 --> 00:40:33,410
in the field that can interact allow me

1045
00:40:38,680 --> 00:40:36,499
to it with the backroom team and allow

1046
00:40:41,259 --> 00:40:38,690
me to interact with my environment in a

1047
00:40:43,029 --> 00:40:41,269
you know virtual sense or an augmented

1048
00:40:46,359 --> 00:40:43,039
reality sense so I want to bring all

1049
00:40:48,039 --> 00:40:46,369
that together without a ton of different

1050
00:40:50,920 --> 00:40:48,049
things in covering me so I don't want my

1051
00:40:52,809 --> 00:40:50,930
iPhone and my app top and my earbuds and

1052
00:40:57,009 --> 00:40:52,819
all this crap I want it to be a seamless

1053
00:41:00,519 --> 00:40:57,019
well designed integrated element in my

1054
00:41:04,120 --> 00:41:00,529
life that that is is is there to help me

1055
00:41:06,339 --> 00:41:04,130
and not encumber me so that's weird like

1056
00:41:08,079 --> 00:41:06,349
kind of systematically working towards

1057
00:41:09,729 --> 00:41:08,089
right now it's a really nascent some of

1058
00:41:11,739 --> 00:41:09,739
the work that we're doing to understand

1059
00:41:15,819 --> 00:41:11,749
the requirements for each simple things

1060
00:41:17,979 --> 00:41:15,829
like what type of handheld spectrometer

1061
00:41:21,370 --> 00:41:17,989
spectrometers do we want to have

1062
00:41:23,440 --> 00:41:21,380
eventually integrated into handheld and

1063
00:41:25,749 --> 00:41:23,450

held tricorder what are the economics of

1064
00:41:27,940 --> 00:41:25,759
it do what I want it to be something

1065
00:41:29,739 --> 00:41:27,950
that's on my chest is that too much of a

1066
00:41:31,269 --> 00:41:29,749
pain because I want to bend down to look

1067
00:41:32,680 --> 00:41:31,279
under an outcrop it kind of gets caught

1068
00:41:35,109 --> 00:41:32,690
on something or whatever don't want it

1069
00:41:37,420 --> 00:41:35,119
to be in hand what is the data that has

1070
00:41:40,539 --> 00:41:37,430
to get sent back so that I'll tell you

1071
00:41:43,029 --> 00:41:40,549
what I don't have enough trucks of money

1072
00:41:44,829 --> 00:41:43,039
or a truck of money at all to enable

1073
00:41:47,259 --> 00:41:44,839
that work to the degree that I want so

1074
00:41:48,940 --> 00:41:47,269
if there's anybody out there that has a

1075
00:41:52,599 --> 00:41:48,950
dump truck of money you'd like to drive

1076
00:41:55,690 --> 00:41:52,609
up to us and help with this endeavor

1077
00:41:58,660 --> 00:41:55,700
let's do it because there are so many

1078
00:42:00,099 --> 00:41:58,670
opportunities to look at work that's

1079
00:42:02,319 --> 00:42:00,109
already been done whether that's

1080
00:42:04,390 --> 00:42:02,329
commercial off-the-shelf instrumentation

1081
00:42:06,219 --> 00:42:04,400
the utilization of those constants to

1082
00:42:10,120 --> 00:42:06,229
different you know environments

1083
00:42:12,339 --> 00:42:10,130
underground underwater underground in on

1084
00:42:15,519 --> 00:42:12,349
on land in these volcanic settings or

1085
00:42:16,420 --> 00:42:15,529
whatever it may be and also the the way

1086
00:42:18,100 --> 00:42:16,430
that people will

1087
00:42:20,650 --> 00:42:18,110
like data and rapidly turnaround

1088
00:42:23,830 --> 00:42:20,660

decisions or maybe it takes time all of

1089
00:42:27,370 --> 00:42:23,840
those all that work that's already been

1090
00:42:29,620 --> 00:42:27,380
done we in many ways we just don't know

1091
00:42:32,020 --> 00:42:29,630
about it and I'd like to know more about

1092
00:42:34,840 --> 00:42:32,030
it so that we can not constantly

1093
00:42:36,580 --> 00:42:34,850
reinvent the wheel so that I can get to

1094
00:42:40,300 --> 00:42:36,590
where I want to go faster which is a

1095
00:42:41,560 --> 00:42:40,310
geological track order yes astrobiology

1096
00:42:43,540 --> 00:42:41,570
is definitely not just a scientific

1097
00:42:44,770 --> 00:42:43,550
endeavor is very much an engineering one

1098
00:42:47,230 --> 00:42:44,780
as well for the reasons you just

1099
00:42:49,150 --> 00:42:47,240
highlighted Anissa thanks for that she

1100
00:42:50,650 --> 00:42:49,160
also points out the question you've

1101
00:42:52,480 --> 00:42:50,660
probably been asked a thousand times

1102
00:43:00,700 --> 00:42:52,490
that you became a little knowledge is

1103
00:43:03,340 --> 00:43:00,710
because your last name is Lynne Adam

1104
00:43:04,750 --> 00:43:03,350
Robinson asks how will astronauts get

1105
00:43:07,600 --> 00:43:04,760
around the planetary protection concerns

1106
00:43:08,170 --> 00:43:07,610
when exploring near possible water on

1107
00:43:09,520 --> 00:43:08,180
Mars

1108
00:43:11,380 --> 00:43:09,530
what about undergraduate exploration

1109
00:43:13,000 --> 00:43:11,390
like in lava tubes where the environment

1110
00:43:16,000 --> 00:43:13,010
is potentially more habitable for

1111
00:43:17,950 --> 00:43:16,010
microbes okay so they won't they won't

1112
00:43:20,830 --> 00:43:17,960
get around planetary protection issues

1113
00:43:22,540 --> 00:43:20,840

it I we can't get around them when we're

1114
00:43:24,100 --> 00:43:22,550
on earth either I mean it has to be

1115
00:43:26,380 --> 00:43:24,110
something that we contend with that we

1116
00:43:29,320 --> 00:43:26,390
deal with that we integrate into our

1117
00:43:32,710 --> 00:43:29,330
planning and something we had hoped to

1118
00:43:34,000 --> 00:43:32,720
do within the basalt project but I don't

1119
00:43:35,680 --> 00:43:34,010
think we're ever going to get to to the

1120
00:43:37,840 --> 00:43:35,690
degree that I want to but I put out

1121
00:43:41,580 --> 00:43:37,850
there to the community to tackle is what

1122
00:43:44,650 --> 00:43:41,590
are the differences between geological

1123
00:43:47,110 --> 00:43:44,660
fieldwork and biologically oriented

1124
00:43:49,660 --> 00:43:47,120
fieldwork and trying to understand

1125
00:43:52,000 --> 00:43:49,670
what's a the planetary protection issues

1126
00:43:54,100 --> 00:43:52,010
are associated with both of those and

1127
00:43:55,900 --> 00:43:54,110
the requirements whether it's with you

1128
00:43:57,880 --> 00:43:55,910
know at your geological headquarter your

1129
00:43:59,830 --> 00:43:57,890
biological tricorder or whether there's

1130
00:44:02,680 --> 00:43:59,840
some composite of that your systems the

1131
00:44:04,510 --> 00:44:02,690
the way that you walk into an area you

1132
00:44:05,800 --> 00:44:04,520
know is it different when you're dealing

1133
00:44:08,290 --> 00:44:05,810
with just collecting rocks for the sake

1134
00:44:09,580 --> 00:44:08,300
of file versus sterile sampling and

1135
00:44:11,680 --> 00:44:09,590
trying to deal with these planetary

1136
00:44:13,570 --> 00:44:11,690
protection issues I don't think we've

1137
00:44:15,250 --> 00:44:13,580
actually as a community done enough of a

1138
00:44:17,800 --> 00:44:15,260

deep dive in terms of understanding the

1139
00:44:20,470 --> 00:44:17,810
nuances between both of those and

1140
00:44:23,560 --> 00:44:20,480
they're going to be huge when we have to

1141
00:44:25,240 --> 00:44:23,570
keep things clean you know from both

1142
00:44:28,120 --> 00:44:25,250
forward and back planetary protection

1143
00:44:30,130 --> 00:44:28,130
perspectives so that's one answer I

1144
00:44:33,490 --> 00:44:30,140
think the other one was what about

1145
00:44:35,710 --> 00:44:33,500
getting into lava tubes so there's

1146
00:44:38,920 --> 00:44:35,720
actually a new project or project that

1147
00:44:42,270 --> 00:44:38,930
was newly funded by the SMD P Start

1148
00:44:44,470 --> 00:44:42,280
program called Braille and the PI is a

1149
00:44:47,620 --> 00:44:44,480
Jennifer Blanc and she's at the SETI

1150
00:44:49,180 --> 00:44:47,630
Institute so she's gonna kill me

1151
00:44:52,150 --> 00:44:49,190
because now probably our inbox will fill

1152
00:44:54,340 --> 00:44:52,160
up but I would say go and talk to Jen

1153
00:44:57,940 --> 00:44:54,350
because her project Braille is actually

1154
00:44:59,140 --> 00:44:57,950
to understand which actually her science

1155
00:45:01,210 --> 00:44:59,150
is actually looking at the microbiology

1156
00:45:04,540 --> 00:45:01,220
of some lava tubes and I think a couple

1157
00:45:06,280 --> 00:45:04,550
of different analog settings and the

1158
00:45:09,700 --> 00:45:06,290
operations element that she's bringing

1159
00:45:11,680 --> 00:45:09,710
into this project is to use our Rover

1160
00:45:13,840 --> 00:45:11,690
systems to actually map out and

1161
00:45:15,490 --> 00:45:13,850
characterize this environment in service

1162
00:45:16,720 --> 00:45:15,500
of the science that she's interested in

1163
00:45:19,150 --> 00:45:16,730

doing which is understanding

1164
00:45:20,350 --> 00:45:19,160
habitability of these lava these lava

1165
00:45:22,330 --> 00:45:20,360
tube environments and of course penny

1166
00:45:24,040 --> 00:45:22,340
Boston has done an incredible amount of

1167
00:45:26,410 --> 00:45:24,050
groundbreaking work on that in that

1168
00:45:29,500 --> 00:45:26,420
field as well and so I'd say you know go

1169
00:45:31,690 --> 00:45:29,510
bug penny too but there's lots of I

1170
00:45:33,010 --> 00:45:31,700
think opportunity as you know coming

1171
00:45:35,410 --> 00:45:33,020
back to what you said Sandra earlier

1172
00:45:36,970 --> 00:45:35,420
which is just put your fingers to the

1173
00:45:38,860 --> 00:45:36,980
keyboard and start emailing people and

1174
00:45:42,610 --> 00:45:38,870
see what comes back at you in terms of

1175
00:45:43,870 --> 00:45:42,620
opportunity cool thanks for that next

1176
00:45:46,690 --> 00:45:43,880
question is from Rohan

1177
00:45:50,460 --> 00:45:46,700
Shira donk our who asks where do you see

1178
00:45:56,260 --> 00:45:50,470
the field of astrobiology in 10 years oh

1179
00:45:58,270 --> 00:45:56,270
so exciting and so ok wow there's so

1180
00:46:03,280 --> 00:45:58,280
many different ways I can answer this

1181
00:46:05,740 --> 00:46:03,290
I hope it's grown I hope that there are

1182
00:46:07,000 --> 00:46:05,750
a lot of people that have been able to

1183
00:46:09,640 --> 00:46:07,010
make a living out of it which is

1184
00:46:11,260 --> 00:46:09,650
actually not a simple thing to envision

1185
00:46:12,760 --> 00:46:11,270
at this point in time because funding is

1186
00:46:14,290 --> 00:46:12,770
limited and yet we still get more and

1187
00:46:17,530 --> 00:46:14,300
more people interested in the field of

1188
00:46:21,100 --> 00:46:17,540

astrobiology and PhDs in terms of the

1189
00:46:22,570 --> 00:46:21,110
science I'm hoping that it will I think

1190
00:46:24,250 --> 00:46:22,580
you know I think the realms of ocean

1191
00:46:26,020 --> 00:46:24,260
worlds will probably become a huge focus

1192
00:46:28,000 --> 00:46:26,030
for astrobiology as we go forward

1193
00:46:30,550 --> 00:46:28,010
there's lots of incredible opportunity

1194
00:46:32,800 --> 00:46:30,560
there in terms of understanding

1195
00:46:35,890 --> 00:46:32,810
habitability within our polar system as

1196
00:46:38,860 --> 00:46:35,900
well as I think in terms of you know the

1197
00:46:40,510 --> 00:46:38,870
world of analogs coming back to to that

1198
00:46:43,000 --> 00:46:40,520
and what I'm familiar with as well is

1199
00:46:45,370 --> 00:46:43,010
that we can use our own earth

1200
00:46:47,650 --> 00:46:45,380
to potentially act as an analog to

1201
00:46:50,730 --> 00:46:47,660
understanding other ocean systems in our

1202
00:46:53,620 --> 00:46:50,740
solar system and so I'd love to see a

1203
00:46:55,570 --> 00:46:53,630
broader buildup of that intersection

1204
00:46:58,120 --> 00:46:55,580
between the ocean sciences and the ocean

1205
00:46:59,560 --> 00:46:58,130
world scientist and I think that's

1206
00:47:01,240 --> 00:46:59,570
getting enabled by people like chris

1207
00:47:02,860 --> 00:47:01,250
german and kevin hand and others and

1208
00:47:05,590 --> 00:47:02,870
really trying to build up that momentum

1209
00:47:07,630 --> 00:47:05,600
so i can only give you my wishes in

1210
00:47:09,010 --> 00:47:07,640
terms of where I hope this you know

1211
00:47:11,160 --> 00:47:09,020
we're heading to in that direction of

1212
00:47:13,420 --> 00:47:11,170
course there's Mars as well and so much

1213
00:47:16,060 --> 00:47:13,430

interest there in trying to understand

1214
00:47:17,860 --> 00:47:16,070
where best to go to move beyond

1215
00:47:20,860 --> 00:47:17,870
geological characterizations into

1216
00:47:22,180 --> 00:47:20,870
directly understanding you know the

1217
00:47:25,870 --> 00:47:22,190
possibility of bio signature

1218
00:47:27,700 --> 00:47:25,880
preservation and and and so forth in

1219
00:47:30,130 --> 00:47:27,710
terms of that planet as well so I think

1220
00:47:32,290 --> 00:47:30,140
the great thing is that the community of

1221
00:47:34,000 --> 00:47:32,300
astrobiologists that we have is is

1222
00:47:35,470 --> 00:47:34,010
growing I hope it continues to grow and

1223
00:47:38,260 --> 00:47:35,480
people are looking beyond the kind of

1224
00:47:41,830 --> 00:47:38,270
traditional targets and we have at our

1225
00:47:43,660 --> 00:47:41,840
disposal now the opportunity to look at

1226
00:47:46,000 --> 00:47:43,670
these in kwatak environments directly on

1227
00:47:47,920 --> 00:47:46,010
earth and throughout our solar system

1228
00:47:51,070 --> 00:47:47,930
and I'm super stoked about where that's

1229
00:47:53,590 --> 00:47:51,080
gonna go yeah me too

1230
00:47:55,180 --> 00:47:53,600
the next question is by a leave Biermann

1231
00:47:57,610 --> 00:47:55,190
who asks thank you for the question is

1232
00:48:02,760 --> 00:47:57,620
it coming to need and see physicists in

1233
00:48:06,730 --> 00:48:02,770
your field yes yes physicists rock

1234
00:48:09,040 --> 00:48:06,740
absolutely we use them in a liminal aaja

1235
00:48:11,920 --> 00:48:09,050
chol sense so the physicists end up

1236
00:48:13,570 --> 00:48:11,930
doing applied work for us we have nathan

1237
00:48:16,480 --> 00:48:13,580
bramble right now for example who is

1238
00:48:19,090 --> 00:48:16,490

really in it plays a very key role for

1239
00:48:20,350 --> 00:48:19,100
us and basalt he actually helps us to

1240
00:48:22,960 --> 00:48:20,360
manage all of the instruments that we

1241
00:48:24,490 --> 00:48:22,970
bring in evaluate their capacity to

1242
00:48:27,760 --> 00:48:24,500
actually help us with decision making

1243
00:48:29,440 --> 00:48:27,770
he helps - he helps us from you know a

1244
00:48:31,570 --> 00:48:29,450
very technical standpoint because of his

1245
00:48:33,760 --> 00:48:31,580
physics background understand the value

1246
00:48:35,350 --> 00:48:33,770
of different spectral capabilities that

1247
00:48:37,030 --> 00:48:35,360
we have so that's just one of many

1248
00:48:38,950 --> 00:48:37,040
different applications that we have for

1249
00:48:40,960 --> 00:48:38,960
physicists our work physicists whether

1250
00:48:42,940 --> 00:48:40,970
they're as well in a number of aquatic

1251
00:48:46,870 --> 00:48:42,950
environments where we're trying to

1252
00:48:48,490 --> 00:48:46,880
understand our ability to to map themes

1253
00:48:50,560 --> 00:48:48,500
environments using autonomous underwater

1254
00:48:52,900 --> 00:48:50,570
vehicles and so there's a lot of applied

1255
00:48:54,820 --> 00:48:52,910
physics that comes into play and those

1256
00:48:56,260 --> 00:48:54,830
circumstances as well so

1257
00:48:59,050 --> 00:48:56,270
I would say if you're an undergrad or

1258
00:49:01,230 --> 00:48:59,060
even in graduate school just you know go

1259
00:49:03,250 --> 00:49:01,240
with what you love but definitely read

1260
00:49:05,020 --> 00:49:03,260
beyond the scope of what you're familiar

1261
00:49:07,330 --> 00:49:05,030
with and then you'll start to understand

1262
00:49:10,210 --> 00:49:07,340
the application of your of your physics

1263
00:49:11,110 --> 00:49:10,220

background different yeah exactly an

1264
00:49:12,970 --> 00:49:11,120
awesome background to get in

1265
00:49:15,040 --> 00:49:12,980
astrobiology because you can go into you

1266
00:49:16,960 --> 00:49:15,050
know into geology into biology into

1267
00:49:18,370 --> 00:49:16,970
instrument design in fact one of my very

1268
00:49:20,410 --> 00:49:18,380
good friends dr. Sarah Walker who's a

1269
00:49:22,480 --> 00:49:20,420
physicist is doing origin of life

1270
00:49:24,550 --> 00:49:22,490
research at Arizona State so it's very

1271
00:49:26,920 --> 00:49:24,560
very broad very useful background to

1272
00:49:28,600 --> 00:49:26,930
have for astrobiology so earlier in this

1273
00:49:30,400 --> 00:49:28,610
in our conversation Darlene you

1274
00:49:31,330 --> 00:49:30,410
mentioned that you are a mom so I was

1275
00:49:32,770 --> 00:49:31,340
wondering if you could tell us a little

1276
00:49:34,480 --> 00:49:32,780
bit how did you balance you know raising

1277
00:49:36,520 --> 00:49:34,490
a family was advancing your scientific

1278
00:49:38,410 --> 00:49:36,530
career sometimes they can be at odds or

1279
00:49:40,000 --> 00:49:38,420
some some of the students you know think

1280
00:49:43,660 --> 00:49:40,010
a lot about these things what has been

1281
00:49:45,880 --> 00:49:43,670
your experience there's no balance every

1282
00:49:47,380 --> 00:49:45,890
day you know well maybe there is a

1283
00:49:49,510 --> 00:49:47,390
balance but it's just like there for a

1284
00:49:51,460 --> 00:49:49,520
hair of a second you know because every

1285
00:49:53,440 --> 00:49:51,470
day I'm not quite sure if I'm gonna drop

1286
00:49:56,100 --> 00:49:53,450
the ball on something and I know I mean

1287
00:49:59,110 --> 00:49:56,110
inevitably a ball drops here and there

1288
00:50:01,960 --> 00:49:59,120

and that's okay it's okay

1289
00:50:05,770 --> 00:50:01,970
I mean you know I think the real the

1290
00:50:07,210 --> 00:50:05,780
real thing is um I just anything any

1291
00:50:10,660 --> 00:50:07,220
moment that I'm doing something I try

1292
00:50:12,580 --> 00:50:10,670
and make sure it's quality time so you

1293
00:50:15,280 --> 00:50:12,590
know within a four hour period now I can

1294
00:50:17,350 --> 00:50:15,290
get a lot done because I just sit at my

1295
00:50:19,750 --> 00:50:17,360
desk and I do not move and like you know

1296
00:50:21,790 --> 00:50:19,760
my my Garmin watch is yelling at me move

1297
00:50:23,110 --> 00:50:21,800
move but I'm like no I have to sit here

1298
00:50:24,220 --> 00:50:23,120
I've got only four hours and then I got

1299
00:50:25,720 --> 00:50:24,230
to go on to the other thing you know

1300
00:50:26,920 --> 00:50:25,730
there's all these different elements

1301
00:50:29,950 --> 00:50:26,930
that are pulling at you that weren't

1302
00:50:31,420 --> 00:50:29,960
there before but is so rewarding and

1303
00:50:33,790 --> 00:50:31,430
again just trying to you know

1304
00:50:35,710 --> 00:50:33,800
thematically be the idea of being an

1305
00:50:38,710 --> 00:50:35,720
explorer and every different aspect of

1306
00:50:41,190 --> 00:50:38,720
your life possible the element and the

1307
00:50:43,360 --> 00:50:41,200
adventure of having children is is

1308
00:50:45,220 --> 00:50:43,370
inexplicably and and I can't even

1309
00:50:47,110 --> 00:50:45,230
articulate the joys and the Wonder and

1310
00:50:48,520 --> 00:50:47,120
them and the challenges and the triumphs

1311
00:50:50,500 --> 00:50:48,530
and the like failures that come with

1312
00:50:51,940 --> 00:50:50,510
that but it's all part of this great

1313
00:50:53,290 --> 00:50:51,950

journey and it's and it's the

1314
00:50:55,030 --> 00:50:53,300
exploration that comes with it whether

1315
00:50:58,060 --> 00:50:55,040
it's personally or just even beyond this

1316
00:50:59,470 --> 00:50:58,070
is um it's totally worth like every

1317
00:51:02,590 --> 00:50:59,480
second of trying to balance everything

1318
00:51:04,810 --> 00:51:02,600
out and I have an amazing support

1319
00:51:05,950 --> 00:51:04,820
network in my mom came in and helped me

1320
00:51:08,410 --> 00:51:05,960
out a lot at the beginning when I was

1321
00:51:11,349 --> 00:51:08,420
trying to build you know this like

1322
00:51:12,759 --> 00:51:11,359
career and managed my little kids and my

1323
00:51:14,940 --> 00:51:12,769
husband too has been a real you know

1324
00:51:18,460 --> 00:51:14,950
equal partner in raising them and so

1325
00:51:20,170 --> 00:51:18,470
that that's just been very I'm really

1326
00:51:23,890 --> 00:51:20,180
grateful for those elements in my life

1327
00:51:26,410 --> 00:51:23,900
cool cool thanks for that so what's next

1328
00:51:27,880 --> 00:51:26,420
for you Darlene like what other project

1329
00:51:33,940 --> 00:51:27,890
are you concocting where are you gonna

1330
00:51:35,650 --> 00:51:33,950
travel to me okay so the next project

1331
00:51:38,740 --> 00:51:35,660
that has actually just started up is

1332
00:51:40,930 --> 00:51:38,750
something called sub C it's also SMD

1333
00:51:43,509 --> 00:51:40,940
funded and I get to work with some great

1334
00:51:46,809 --> 00:51:43,519
scientists IRA Shaka Chris German Julie

1335
00:51:48,640 --> 00:51:46,819
Huber record in - right yeah yeah and

1336
00:51:51,039 --> 00:51:48,650
like you know what's so funny is usually

1337
00:51:52,750 --> 00:51:51,049
I picked the word and then I asked my

1338
00:51:54,789 --> 00:51:52,760

buddies to come up with the words to

1339
00:51:56,650 --> 00:51:54,799
pick to fit the word and so I can never

1340
00:51:58,539 --> 00:51:56,660
actually remember what it stands for so

1341
00:52:01,420 --> 00:51:58,549
if you have its own of the awesome okay

1342
00:52:04,000 --> 00:52:01,430
great that's the sub C is a systemic

1343
00:52:11,230 --> 00:52:04,010
underwater biogeochemical science and

1344
00:52:12,400 --> 00:52:11,240
exploration analog guys do we I'm super

1345
00:52:15,309 --> 00:52:12,410
stoked so it's actually a partnership

1346
00:52:19,029 --> 00:52:15,319
between of course you know the the NASA

1347
00:52:20,799 --> 00:52:19,039
element as well as NOAA and we're going

1348
00:52:22,569 --> 00:52:20,809
to be coming back to some earlier

1349
00:52:24,549 --> 00:52:22,579
statements and things that we talked

1350
00:52:26,589 --> 00:52:24,559
about actually using the Earth's ocean

1351
00:52:28,690 --> 00:52:26,599
as an analogue to Enceladus so we're

1352
00:52:31,900 --> 00:52:28,700
gonna be working at intra plate margins

1353
00:52:35,079 --> 00:52:31,910
I'm just immune exactly exactly and the

1354
00:52:36,730 --> 00:52:35,089
hydro the hydrothermal systems

1355
00:52:38,470 --> 00:52:36,740
associated with these interplay margins

1356
00:52:39,700 --> 00:52:38,480
so we're gonna start with Loihi which is

1357
00:52:41,470 --> 00:52:39,710
off the coast of the Big Island of

1358
00:52:44,079 --> 00:52:41,480
Hawaii and we're have a we're gonna be

1359
00:52:48,309 --> 00:52:44,089
working with the with NOAA and the ocean

1360
00:52:49,539 --> 00:52:48,319
exploration trust which and working on

1361
00:52:51,940 --> 00:52:49,549
their ship called the Nautilus and

1362
00:52:54,009 --> 00:52:51,950
they're working class ROV which goes

1363
00:52:55,089 --> 00:52:54,019

down about four kilometers we will be

1364
00:52:56,470 --> 00:52:55,099
exploring this site and trying to

1365
00:52:59,620 --> 00:52:56,480
understand the energetics or what

1366
00:53:01,299 --> 00:52:59,630
creates habitable environments if he is

1367
00:53:03,700 --> 00:53:01,309
an underwater volcano right this the

1368
00:53:04,210 --> 00:53:03,710
next how I invite right yeah that's it

1369
00:53:06,640 --> 00:53:04,220
exactly

1370
00:53:08,109 --> 00:53:06,650
so our team is gonna look at this

1371
00:53:10,539 --> 00:53:08,119
environment scientifically from the

1372
00:53:12,220 --> 00:53:10,549
standpoint of energetics biology geology

1373
00:53:13,990 --> 00:53:12,230
and then you know sort of bringing all

1374
00:53:16,059 --> 00:53:14,000
that together to build a picture but

1375
00:53:19,509 --> 00:53:16,069
then of course I always like the twist

1376
00:53:21,910 --> 00:53:19,519
so the twist is that this the setup that

1377
00:53:23,319 --> 00:53:21,920
at the ocean exploration community

1378
00:53:25,510 --> 00:53:23,329
as in terms of their mission set up is

1379
00:53:27,250 --> 00:53:25,520
that there's a ship it goes out to their

1380
00:53:28,960 --> 00:53:27,260
destination but you can't bring all the

1381
00:53:31,030 --> 00:53:28,970
scientists on the ship most of them have

1382
00:53:33,789 --> 00:53:31,040
to sit on shore and they tend to sit all

1383
00:53:35,680 --> 00:53:33,799
over the world but you know NOAA and the

1384
00:53:38,799 --> 00:53:35,690
O NOAA and other organizations have

1385
00:53:40,599 --> 00:53:38,809
great mission architectures that enable

1386
00:53:42,730 --> 00:53:40,609
the dialogue between those scientists

1387
00:53:44,170 --> 00:53:42,740
and the shipboard crew so that their

1388
00:53:45,849 --> 00:53:44,180

science objectives are met so we're

1389
00:53:47,829 --> 00:53:45,859
going to use the operations research

1390
00:53:49,630 --> 00:53:47,839
that we're doing in subsea is going to

1391
00:53:51,819 --> 00:53:49,640
examine that architecture that work

1392
00:53:53,410 --> 00:53:51,829
domain and really characterize it again

1393
00:53:55,030 --> 00:53:53,420
so that we don't reinvent the wheel when

1394
00:53:56,859 --> 00:53:55,040
we start to think about mission

1395
00:53:58,870 --> 00:53:56,869
architectures such as low latency tele

1396
00:54:00,400 --> 00:53:58,880
operations whether that be in any

1397
00:54:02,770 --> 00:54:00,410
destination you know from harrier to

1398
00:54:04,720 --> 00:54:02,780
Mars or onwards and that is where you

1399
00:54:08,170 --> 00:54:04,730
for example if you have humans orbiting

1400
00:54:10,870 --> 00:54:08,180
Mars operating a rover in low latency

1401
00:54:13,539 --> 00:54:10,880
communication between that orbit and

1402
00:54:15,160 --> 00:54:13,549
then and then Mars but of course the

1403
00:54:16,390 --> 00:54:15,170
crew that's orbiting Mars will still if

1404
00:54:17,980 --> 00:54:16,400
they want to interact with earth they're

1405
00:54:20,380 --> 00:54:17,990
still going to be a latency but they're

1406
00:54:21,839 --> 00:54:20,390
going to have the opportunity to talk

1407
00:54:23,770 --> 00:54:21,849
with scientists on earth that may be

1408
00:54:27,490 --> 00:54:23,780
co-located or sitting all over the world

1409
00:54:30,390 --> 00:54:27,500
but that's really amazingly and very

1410
00:54:32,829 --> 00:54:30,400
highly analogous to what the the

1411
00:54:35,289 --> 00:54:32,839
Nautilus has in terms of their doctors

1412
00:54:37,299 --> 00:54:35,299
on-call system where they they call up

1413
00:54:39,309 --> 00:54:37,309

you know some specialized PhD in some

1414
00:54:41,950 --> 00:54:39,319
area if they find some interesting squid

1415
00:54:43,480 --> 00:54:41,960
or whatever and and you know formulate

1416
00:54:46,480 --> 00:54:43,490
that discussion in a way which is going

1417
00:54:48,849 --> 00:54:46,490
to impact the operations of the Nautilus

1418
00:54:50,440 --> 00:54:48,859
so so there's a science operations end

1419
00:54:51,549 --> 00:54:50,450
of things as science end of things and

1420
00:54:53,500 --> 00:54:51,559
then there's a tech end of things where

1421
00:54:55,930 --> 00:54:53,510
we're trying to look at the capabilities

1422
00:54:57,640 --> 00:54:55,940
that we need software wise to aggregate

1423
00:54:59,559 --> 00:54:57,650
that information and put it out to the

1424
00:55:01,539 --> 00:54:59,569
research community in a meaningful way

1425
00:55:04,809 --> 00:55:01,549
so they can you know interact with the

1426
00:55:05,920 --> 00:55:04,819
on the ship so I'm that's that's in the

1427
00:55:07,900 --> 00:55:05,930
immediate and then there are lots of

1428
00:55:09,819 --> 00:55:07,910
other thoughts about the future where we

1429
00:55:11,380 --> 00:55:09,829
want to go looking at human robotic

1430
00:55:14,609 --> 00:55:11,390
interactions and when it comes to

1431
00:55:16,599 --> 00:55:14,619
science ops and and and things like that

1432
00:55:20,589 --> 00:55:16,609
would you go to Mars tomorrow if you

1433
00:55:25,839 --> 00:55:20,599
could only if I could come back that's

1434
00:55:27,640 --> 00:55:25,849
I'm not a one way kind of person Darlene

1435
00:55:29,380 --> 00:55:27,650
what you do is it's just so cool and I'm

1436
00:55:30,940 --> 00:55:29,390
so grateful that you took the time today

1437
00:55:33,130 --> 00:55:30,950
to chat with us it's been an incredible

1438
00:55:33,880 --> 00:55:33,140

conversation those of you who are

1439
00:55:35,130 --> 00:55:33,890
watching

1440
00:55:37,470 --> 00:55:35,140
remember the

1441
00:55:39,210 --> 00:55:37,480
background quiz what is behind me we'll

1442
00:55:40,680 --> 00:55:39,220
give you the answer next time I won't

1443
00:55:41,880 --> 00:55:40,690
give a big shout-out to our own Sharma

1444
00:55:44,400 --> 00:55:41,890
who guests was the first to guess

1445
00:55:47,520 --> 00:55:44,410
correctly the giant red spot which was

1446
00:55:49,500 --> 00:55:47,530
awesome so until then everybody stay