Episode 7: July 13th, 2017

Dr. Alexis Templeton

NASA Astrobiology Program

1
00:00:00,510 --> 00:00:29,830
[Music]

2
00:00:33,950 --> 00:00:31,939
greetings friends of astrobiology

3
00:00:36,889 --> 00:00:33,960
welcome back to a brand new episode of

4
00:00:39,560 --> 00:00:36,899
ask an astrobiologist this show is made

5
00:00:42,500 --> 00:00:39,570
possible by contributions from the NASA

6
00:00:44,569 --> 00:00:42,510
Astrobiology program Elsi the earth Life

7
00:00:46,400 --> 00:00:44,579
Science Institute and a non-profit blue

8
00:00:48,650 --> 00:00:46,410
marble space in this show we celebrate

9
00:00:49,700 --> 00:00:48,660
science and celebrate scientists and

10
00:00:51,529 --> 00:00:49,710
today is no different

11
00:00:55,340 --> 00:00:51,539
my name is Sanjay um and we are very

12
00:00:57,110 --> 00:00:55,350
lucky to to have dr. Alexis Templeton of

13
00:00:59,689 --> 00:00:57,120

the University of Colorado at Boulder as

14
00:01:03,200 --> 00:00:59,699
our guest today but first it's your

15
00:01:05,390 --> 00:01:03,210
monthly background quiz so Mike if you

16
00:01:08,750 --> 00:01:05,400
could put up the background from last

17
00:01:11,090 --> 00:01:08,760
month where we featured these very

18
00:01:13,190 --> 00:01:11,100
strange shapes from a land far far away

19
00:01:16,550 --> 00:01:13,200
at least from our studio here in

20
00:01:18,770 --> 00:01:16,560
California in the United States and one

21
00:01:19,550 --> 00:01:18,780
person got it rights and congratulations

22
00:01:22,460 --> 00:01:19,560
Shana

23
00:01:25,130 --> 00:01:22,470
Kendall who's tweeting as NASA JPL fan

24
00:01:27,950 --> 00:01:25,140
who correctly identified the site as the

25
00:01:29,840 --> 00:01:27,960
Pilbara in Western Australia and these

26
00:01:32,300 --> 00:01:29,850
features are actually evidence of life

27
00:01:33,710 --> 00:01:32,310
that occurred on earth three billion

28
00:01:35,600 --> 00:01:33,720
years ago and they're called

29
00:01:37,190 --> 00:01:35,610
stromatolites so they're essentially

30
00:01:39,200 --> 00:01:37,200
microbial mats they were kind of

31
00:01:40,520 --> 00:01:39,210
building up in shallow water and they

32
00:01:42,410 --> 00:01:40,530
were looking for the for the lights so

33
00:01:44,149 --> 00:01:42,420
as they go up you know they have little

34
00:01:46,899 --> 00:01:44,159
filaments that baffle the water the

35
00:01:49,340 --> 00:01:46,909
sediments dropped and the cones grow and

36
00:01:50,840 --> 00:01:49,350
because they are battling sediment rock

37
00:01:53,179 --> 00:01:50,850
lasts a long time and they are now

38
00:01:56,749 --> 00:01:53,189

available for scientists to study so

39
00:01:57,830 --> 00:01:56,759
this is what life on Earth existed three

40
00:02:00,950 --> 00:01:57,840
billion years ago

41
00:02:02,929 --> 00:02:00,960
it's almost goosebump generating this

42
00:02:04,639 --> 00:02:02,939
month this is the background

43
00:02:07,940 --> 00:02:04,649
hopefully it's a lot easier for you guys

44
00:02:10,760 --> 00:02:07,950
because on Monday a spacecraft called

45
00:02:13,310 --> 00:02:10,770
Juno over flew this feature at an

46
00:02:15,650 --> 00:02:13,320
altitude of 9000 km

47
00:02:18,350 --> 00:02:15,660
so grazing the surface of this

48
00:02:20,540 --> 00:02:18,360
environment and I welcome you to share

49
00:02:23,300 --> 00:02:20,550
with you picture without us what do you

50
00:02:25,190 --> 00:02:23,310
think this environment is and you can do

51
00:02:28,640 --> 00:02:25,200
it either on a stake in a chat or on

52
00:02:31,100 --> 00:02:28,650
Twitter with hashtag ask Astra bio if at

53
00:02:33,260 --> 00:02:31,110
any time during this this interview you

54
00:02:35,870 --> 00:02:33,270
have questions for dr. Templeton please

55
00:02:38,180 --> 00:02:35,880
use hashtag ask s for bio on Twitter to

56
00:02:40,700 --> 00:02:38,190
let us know or use the Signet org chat

57
00:02:43,490 --> 00:02:40,710
alright enough about me talking welcome

58
00:02:45,560 --> 00:02:43,500
dr. Alex's Templeton again professor of

59
00:02:47,960 --> 00:02:45,570
geological science at the University of

60
00:02:50,720 --> 00:02:47,970
Colorado Boulder as well as the lead

61
00:02:52,760 --> 00:02:50,730
principal investigator of the NASA

62
00:02:54,770 --> 00:02:52,770
Astrobiology Institute steam rock

63
00:02:57,020 --> 00:02:54,780

powered life and we'll talk a little bit

64
00:02:58,670 --> 00:02:57,030
about that during this interview but

65
00:03:01,010 --> 00:02:58,680
first Alexis thank you so much for being

66
00:03:02,510 --> 00:03:01,020
here with us today I say enjoy it's

67
00:03:05,660 --> 00:03:02,520
great to see you I always love talking

68
00:03:07,370 --> 00:03:05,670
with you thank you and as we like to

69
00:03:08,660 --> 00:03:07,380
start in these interviews it's actually

70
00:03:12,470 --> 00:03:08,670
turn back the wheels of time a little

71
00:03:13,970 --> 00:03:12,480
bit and to begin like how did you become

72
00:03:15,950 --> 00:03:13,980
a scientist as a kid was there any

73
00:03:17,990 --> 00:03:15,960
particular events or stories that that

74
00:03:21,500 --> 00:03:18,000
triggered this lifelong interest in

75
00:03:23,810 --> 00:03:21,510
science and it's a good question um I

76
00:03:27,050 --> 00:03:23,820
took a long time I think for me to

77
00:03:29,300 --> 00:03:27,060
recognize myself as a scientist I think

78
00:03:32,210 --> 00:03:29,310
I always had an adventurous spirit so

79
00:03:35,360 --> 00:03:32,220
that was more of my earlier lifestyle is

80
00:03:37,220 --> 00:03:35,370
really enjoying being out and traveling

81
00:03:39,320 --> 00:03:37,230
in the world both with my family and

82
00:03:41,240 --> 00:03:39,330
then over time I did a lot of outdoor

83
00:03:43,370 --> 00:03:41,250
programs the equivalent of our bounded

84
00:03:45,949 --> 00:03:43,380
Knowles and outdoor educator programs

85
00:03:49,460 --> 00:03:45,959
and so that drove me to go to

86
00:03:51,260 --> 00:03:49,470
interesting places and then I started to

87
00:03:54,680 --> 00:03:51,270
ask questions about the landscapes I was

88
00:03:56,750 --> 00:03:54,690

in and found myself sucked into the the

89
00:03:58,250 --> 00:03:56,760
field I am in now and the geosciences I

90
00:04:01,430 --> 00:03:58,260
would never have guessed as growing up

91
00:04:04,160 --> 00:04:01,440
I'd be a geologist by training but that

92
00:04:06,550 --> 00:04:04,170
underlying interest in chemistry and in

93
00:04:08,960 --> 00:04:06,560
outdoor earths came together in that way

94
00:04:10,760 --> 00:04:08,970
indeed and rocks are indeed the history

95
00:04:12,590 --> 00:04:10,770
books of the planet and learning how to

96
00:04:14,449 --> 00:04:12,600
read them uncover is the most incredible

97
00:04:16,849 --> 00:04:14,459
story at least I find perhaps I'm a bit

98
00:04:19,760 --> 00:04:16,859
biased that one has ever looked at so

99
00:04:21,620 --> 00:04:19,770
but but you are also a microbiologist

100
00:04:24,140 --> 00:04:21,630
right your current research deals a lot

101
00:04:26,400 --> 00:04:24,150
with microbes how did that path unfold

102
00:04:30,100 --> 00:04:26,410
in at university and beyond

103
00:04:32,650 --> 00:04:30,110
so I didn't take any biology actually in

104
00:04:36,370 --> 00:04:32,660
high school or college probably

105
00:04:38,740 --> 00:04:36,380
shouldn't admit that but I I was working

106
00:04:40,629 --> 00:04:38,750
in New Zealand after my undergraduate I

107
00:04:42,460 --> 00:04:40,639
was doing a masters down there and and

108
00:04:44,290 --> 00:04:42,470
again I was really interested in dynamic

109
00:04:46,420 --> 00:04:44,300
landscape so I had gone to New Zealand

110
00:04:48,730 --> 00:04:46,430
because they are mountains that are

111
00:04:51,010 --> 00:04:48,740
forming today they rise three kilometres

112
00:04:53,379 --> 00:04:51,020
up from the ocean and they're through

113
00:04:55,150 --> 00:04:53,389

active plate tectonics and I went to

114
00:04:57,430 --> 00:04:55,160
study the chemistry of the hydrothermal

115
00:04:59,909 --> 00:04:57,440
systems in New Zealand and to do that

116
00:05:01,990 --> 00:04:59,919
through isotope tracers and other

117
00:05:04,839 --> 00:05:02,000
geochemical chasers that we are using

118
00:05:06,550 --> 00:05:04,849
and every time we tried to interpret the

119
00:05:08,050 --> 00:05:06,560
signals and the minerals that we are

120
00:05:10,240 --> 00:05:08,060
studying they didn't make sense through

121
00:05:12,730 --> 00:05:10,250
any of our models so I had to start

122
00:05:14,650 --> 00:05:12,740
reading microbiology literature and in

123
00:05:18,070 --> 00:05:14,660
this point in time it was in the early

124
00:05:20,469 --> 00:05:18,080
90s and only process that would make

125
00:05:22,120 --> 00:05:20,479
sense for the for the signals we were

126
00:05:24,939 --> 00:05:22,130
seeing was that there was organisms

127
00:05:26,890 --> 00:05:24,949
making methane and I didn't know much

128
00:05:28,570 --> 00:05:26,900
about microbial methanogenesis but it

129
00:05:33,100 --> 00:05:28,580
was the first metabolism that I learned

130
00:05:34,960 --> 00:05:33,110
about and I later was given a job I

131
00:05:38,050 --> 00:05:34,970
worked for the US government working on

132
00:05:39,790 --> 00:05:38,060
bioremediation because because of that

133
00:05:42,339 --> 00:05:39,800
research I'd started to learn how do you

134
00:05:43,300 --> 00:05:42,349
trace signals of biological activity so

135
00:05:45,670 --> 00:05:43,310
I essentially started to learn

136
00:05:47,560 --> 00:05:45,680
microbiology on the job I was given

137
00:05:50,290 --> 00:05:47,570
opportunities to take classes and go to

138
00:05:53,050 --> 00:05:50,300

biology departments and in embed

139
00:05:54,839 --> 00:05:53,060
microbiology into my research but it it

140
00:05:57,659 --> 00:05:54,849
came from the side rather than a

141
00:06:01,120 --> 00:05:57,669
directed course of study that I did

142
00:06:02,950 --> 00:06:01,130
earlier on in my career it becomes clear

143
00:06:04,689 --> 00:06:02,960
that it's harder and harder to untangle

144
00:06:06,790 --> 00:06:04,699
geological processes from biological

145
00:06:08,860 --> 00:06:06,800
processes that they overlap quite a lot

146
00:06:11,770 --> 00:06:08,870
so you mentioned bioremediation which is

147
00:06:15,040 --> 00:06:11,780
of course the use of microbes to fight

148
00:06:16,149 --> 00:06:15,050
pollutants caused by human activity is

149
00:06:17,770 --> 00:06:16,159
that something that you're still

150
00:06:19,089 --> 00:06:17,780
pursuing and in what environments for

151
00:06:22,300 --> 00:06:19,099
you what kind of pollutants were you're

152
00:06:24,939 --> 00:06:22,310
fighting against yeah I'm not working in

153
00:06:27,850 --> 00:06:24,949
that area anymore although I teach some

154
00:06:30,070 --> 00:06:27,860
aspects of that so when I've taught

155
00:06:31,960 --> 00:06:30,080
equivalent of Geo microbiology classes

156
00:06:34,690 --> 00:06:31,970
we look a lot at how organisms are

157
00:06:38,200 --> 00:06:34,700
harnessed to convert say toxic forms of

158
00:06:39,020 --> 00:06:38,210
metals into non-toxic forms and at this

159
00:06:40,520 --> 00:06:39,030
point in time I

160
00:06:42,470 --> 00:06:40,530
when I was working for Department of

161
00:06:44,720 --> 00:06:42,480
Energy it was we are looking at

162
00:06:46,220 --> 00:06:44,730
breakdown of petroleum hydrocarbons so

163
00:06:48,440 --> 00:06:46,230

that's where the methane component came

164
00:06:50,320 --> 00:06:48,450
in because we would look at how bacteria

165
00:06:52,310 --> 00:06:50,330
could be stimulated to break down

166
00:06:54,350 --> 00:06:52,320
hydrocarbons to just convert him to

167
00:06:58,070 --> 00:06:54,360
methane then oxidize the methane eat it

168
00:07:00,200 --> 00:06:58,080
and release the co2 and how you could

169
00:07:03,290 --> 00:07:00,210
accelerate that process so that was a

170
00:07:05,450 --> 00:07:03,300
lot of work with engineers and chemists

171
00:07:08,350 --> 00:07:05,460
and microbiologist so it's also the very

172
00:07:10,490 --> 00:07:08,360
beginning of being pushed towards a

173
00:07:12,880 --> 00:07:10,500
interdisciplinary point of view of how

174
00:07:15,770 --> 00:07:12,890
you tackle any kind of complex problem

175
00:07:17,450 --> 00:07:15,780
so I think it's a hugely important area

176
00:07:19,340 --> 00:07:17,460
of research I love seeing students go

177
00:07:22,090 --> 00:07:19,350
into areas of bioremediation but I

178
00:07:25,160 --> 00:07:22,100
myself am I'm not studying it directly

179
00:07:27,140 --> 00:07:25,170
as I could see that yet the seeds of an

180
00:07:28,700 --> 00:07:27,150
astrobiologist even before he became an

181
00:07:30,710 --> 00:07:28,710
astrobiologist by working with engineers

182
00:07:32,600 --> 00:07:30,720
are learning about biology and and

183
00:07:34,340 --> 00:07:32,610
having degrees in geology and that's

184
00:07:36,080 --> 00:07:34,350
kind of all came together in your

185
00:07:38,000 --> 00:07:36,090
current research work was it really to

186
00:07:40,940 --> 00:07:38,010
understand this interaction of biology

187
00:07:42,110 --> 00:07:40,950
and geology in generating gases you

188
00:07:45,860 --> 00:07:42,120

mentioned methane and there are others

189
00:07:48,590 --> 00:07:45,870
to support biological activity on earth

190
00:07:50,630 --> 00:07:48,600
and possibly elsewhere right right so

191
00:07:53,750 --> 00:07:50,640
it's funny how over time your own

192
00:07:55,280 --> 00:07:53,760
awareness of how your work or the things

193
00:07:57,980 --> 00:07:55,290
you're interested in connect to other

194
00:07:59,870 --> 00:07:57,990
fields it helped by being walking in the

195
00:08:01,940 --> 00:07:59,880
doors of engineering and biology and

196
00:08:03,650 --> 00:08:01,950
geology because and I kept hearing about

197
00:08:05,540 --> 00:08:03,660
the problems people are studying and

198
00:08:07,520 --> 00:08:05,550
learn to see the connections between

199
00:08:08,840 --> 00:08:07,530
those disciplines so that was probably

200
00:08:12,200 --> 00:08:08,850
the best thing that happened to me and

201
00:08:14,540 --> 00:08:12,210
this was all before my PhD so it did

202
00:08:16,790 --> 00:08:14,550
shape the way I approached going back to

203
00:08:18,290 --> 00:08:16,800
get a doctorate and when I decided I

204
00:08:21,290 --> 00:08:18,300
wanted to get a doctorate I knew that I

205
00:08:22,730 --> 00:08:21,300
wanted to be able to take courses and

206
00:08:25,370 --> 00:08:22,740
work with people in different

207
00:08:26,960 --> 00:08:25,380
disciplines and so I had two advisors in

208
00:08:31,820 --> 00:08:26,970
two you know one's an engineering one

209
00:08:33,860 --> 00:08:31,830
was in committee or chemistry I took a

210
00:08:36,020 --> 00:08:33,870
lot of my courses and those t8 actually

211
00:08:37,760 --> 00:08:36,030
in departments like that and then when I

212
00:08:40,430 --> 00:08:37,770
finished my PhD I moved to a marine

213
00:08:43,310 --> 00:08:40,440

biology department to do my postdoc so I

214
00:08:44,720 --> 00:08:43,320
forced myself out of field I did not

215
00:08:46,700 --> 00:08:44,730
know marine biology so it's a little

216
00:08:48,350 --> 00:08:46,710
scary always to jump into a you know

217
00:08:52,070 --> 00:08:48,360
another unit or another field you don't

218
00:08:52,520 --> 00:08:52,080
know but there was really cool questions

219
00:08:54,680 --> 00:08:52,530
you could

220
00:08:56,780 --> 00:08:54,690
studying marine biology from a Geo

221
00:08:58,490 --> 00:08:56,790
perspective and so they were I found

222
00:09:01,580 --> 00:08:58,500
most departments are really welcoming of

223
00:09:04,850 --> 00:09:01,590
people coming in from the outside and

224
00:09:06,260 --> 00:09:04,860
I've taken advantage of that yeah and it

225
00:09:07,760 --> 00:09:06,270
just brings up a really good point in a

226
00:09:11,120 --> 00:09:07,770
sense that you did your doctorate thesis

227
00:09:12,950 --> 00:09:11,130
in one topic and you started work your

228
00:09:14,540 --> 00:09:12,960
professional career in another so an

229
00:09:16,340 --> 00:09:14,550
amazing students I know like worried

230
00:09:18,170 --> 00:09:16,350
that by focusing their degrees you know

231
00:09:19,460 --> 00:09:18,180
getting a PhD they're just pigeonholing

232
00:09:20,660 --> 00:09:19,470
themselves for the rest of their lives

233
00:09:22,730 --> 00:09:20,670
which is not the case you're the perfect

234
00:09:24,590 --> 00:09:22,740
example right going into you know a

235
00:09:27,290 --> 00:09:24,600
marine sciences and then coming back to

236
00:09:30,320 --> 00:09:27,300
our Sciences and now astrobiology you

237
00:09:33,050 --> 00:09:30,330
know down the line so that's cool yeah I

238
00:09:34,970 --> 00:09:33,060

think it's important that it would be

239
00:09:37,040 --> 00:09:34,980
too hard to pigeonhole yourself early

240
00:09:38,540 --> 00:09:37,050
and sometimes people know from a very

241
00:09:40,160 --> 00:09:38,550
young age they want to answer a certain

242
00:09:41,540 --> 00:09:40,170
question and so then they're seeking the

243
00:09:44,330 --> 00:09:41,550
training that gets them there towards

244
00:09:46,310 --> 00:09:44,340
that question but a lot of times what

245
00:09:47,900 --> 00:09:46,320
you're the skills you're developing at

246
00:09:49,670 --> 00:09:47,910
one certain stage in your educational

247
00:09:51,200 --> 00:09:49,680
career can be applied to in wildly

248
00:09:55,490 --> 00:09:51,210
different problems and so I think always

249
00:09:57,140 --> 00:09:55,500
staying open to that and and feeling the

250
00:10:00,710 --> 00:09:57,150
confidence that you can you can shift

251
00:10:02,180 --> 00:10:00,720
direction is really important and I

252
00:10:04,310 --> 00:10:02,190
think a lot of the times you don't need

253
00:10:05,900 --> 00:10:04,320
to classify yourself too strongly as one

254
00:10:07,610 --> 00:10:05,910
discipline or another but think about

255
00:10:10,040 --> 00:10:07,620
what you bring from your disciplinary

256
00:10:11,540 --> 00:10:10,050
training to another field is that

257
00:10:13,940 --> 00:10:11,550
something that was self taught so did

258
00:10:15,290 --> 00:10:13,950
you benefit from mentoring during your

259
00:10:17,020 --> 00:10:15,300
academic career while you were at

260
00:10:20,380 --> 00:10:17,030
university

261
00:10:24,020 --> 00:10:20,390
so yeah mentoring is a funny word I um

262
00:10:26,990 --> 00:10:24,030
I've had many great mentors in terms of

263
00:10:29,060 --> 00:10:27,000

the fact I had senior faculty or or

264
00:10:32,350 --> 00:10:29,070
colleagues people might be my boss when

265
00:10:34,760 --> 00:10:32,360
I was working and not in school who

266
00:10:36,170 --> 00:10:34,770
opened doors for me when they understood

267
00:10:38,329 --> 00:10:36,180
what I was excited about at that moment

268
00:10:41,150 --> 00:10:38,339
in time what I wanted to put my energy

269
00:10:42,740 --> 00:10:41,160
into they were always willing to find a

270
00:10:45,170 --> 00:10:42,750
path to help support me in doing that

271
00:10:46,940 --> 00:10:45,180
and so that was a really wonderful form

272
00:10:49,430 --> 00:10:46,950
of mentorship you really need the

273
00:10:51,350 --> 00:10:49,440
support often of many other people that

274
00:10:55,340 --> 00:10:51,360
have that different perspective or

275
00:10:56,930 --> 00:10:55,350
opportunity or connections one of the

276
00:10:58,760 --> 00:10:56,940
things I think about a lot for early

277
00:11:01,860 --> 00:10:58,770
career scientists is the amount I was

278
00:11:04,380 --> 00:11:01,870
mentored by my peers and

279
00:11:06,060 --> 00:11:04,390
your peer group matters so much and what

280
00:11:07,290 --> 00:11:06,070
you define is your peer group is

281
00:11:09,350 --> 00:11:07,300
individual I mean we all have our

282
00:11:12,600 --> 00:11:09,360
different way of thinking about it but I

283
00:11:15,240 --> 00:11:12,610
was really lucky that in graduate school

284
00:11:17,550 --> 00:11:15,250
and my PhD and in my postdoc I worked

285
00:11:20,160 --> 00:11:17,560
with really good people meaning other

286
00:11:21,930 --> 00:11:20,170
good students and postdocs both in the

287
00:11:24,510 --> 00:11:21,940
unit's I was in and then when I go to

288
00:11:27,210 --> 00:11:24,520

conferences and meet my community and

289
00:11:30,019 --> 00:11:27,220
and those people remain my friends and

290
00:11:32,730 --> 00:11:30,029
they're my colleagues and collaborators

291
00:11:36,290 --> 00:11:32,740
going you know 20 years on for me now

292
00:11:38,910 --> 00:11:36,300
and I respected so much about they

293
00:11:41,190 --> 00:11:38,920
individually were either excited about

294
00:11:44,010 --> 00:11:41,200
or had expertise or really creative

295
00:11:46,140 --> 00:11:44,020
ideas about and I think learning to

296
00:11:48,630 --> 00:11:46,150
realize how the strengths of your peers

297
00:11:50,310 --> 00:11:48,640
what you can share and bring to each

298
00:11:52,620 --> 00:11:50,320
other how to communicate with each other

299
00:11:54,750 --> 00:11:52,630
collaborate with each other is really

300
00:11:56,490 --> 00:11:54,760
important and then you are going to see

301
00:11:59,370 --> 00:11:56,500
these same people whether you know it or

302
00:12:02,760 --> 00:11:59,380
not year after year and usually it's

303
00:12:05,220 --> 00:12:02,770
positive so I see it with AB grad Khan I

304
00:12:07,829 --> 00:12:05,230
think it's a great forum for students to

305
00:12:09,180 --> 00:12:07,839
start to in a very informal setting get

306
00:12:11,579 --> 00:12:09,190
to know each other and talk about what

307
00:12:13,320 --> 00:12:11,589
their work is and then to see them see

308
00:12:15,960 --> 00:12:13,330
each other again year after year or I

309
00:12:18,750 --> 00:12:15,970
was just at apps icon and in April and

310
00:12:20,550 --> 00:12:18,760
the number of students that already had

311
00:12:22,199 --> 00:12:20,560
a network because they've been going to

312
00:12:24,810 --> 00:12:22,209
add Greg Khan or other things supported

313
00:12:26,640 --> 00:12:24,820

by the NAI or other agencies so that

314
00:12:28,320 --> 00:12:26,650
they felt like they weren't alone and

315
00:12:29,790 --> 00:12:28,330
they were so connected and RD knew about

316
00:12:32,400 --> 00:12:29,800
each other sciences and then could be

317
00:12:34,199 --> 00:12:32,410
directed to to more work that they

318
00:12:38,370 --> 00:12:34,209
should go see or people they should talk

319
00:12:40,680 --> 00:12:38,380
to that is really important so it

320
00:12:42,420 --> 00:12:40,690
benefited me that I had a really good

321
00:12:43,710 --> 00:12:42,430
peer group and I still know many of

322
00:12:45,900 --> 00:12:43,720
those colleagues and a lot of us went on

323
00:12:47,910 --> 00:12:45,910
professionally ended all sorts of

324
00:12:49,320 --> 00:12:47,920
different jobs and I we still see each

325
00:12:51,750 --> 00:12:49,330
other even though we didn't plan it that

326
00:12:54,870 --> 00:12:51,760
way yeah I mean it's impossible to be a

327
00:12:56,790 --> 00:12:54,880
solo astrobiologists because the themes

328
00:12:58,410 --> 00:12:56,800
are so vast and you need input from

329
00:13:00,480 --> 00:12:58,420
different disciplines to engage your

330
00:13:01,890 --> 00:13:00,490
personal science and just for those of

331
00:13:03,600 --> 00:13:01,900
you who do not familiar with AB grad

332
00:13:05,610 --> 00:13:03,610
command apps icon a grad Khan is the

333
00:13:07,350 --> 00:13:05,620
astrobiology graduate student conference

334
00:13:09,810 --> 00:13:07,360
which is a conference organized and held

335
00:13:11,160 --> 00:13:09,820
only for students and AB psychology

336
00:13:12,540 --> 00:13:11,170
astrobiology science conference is the

337
00:13:14,520 --> 00:13:12,550
big science conference for all

338
00:13:15,449 --> 00:13:14,530

astrobiologists that we had this past

339
00:13:16,259 --> 00:13:15,459
April which is

340
00:13:18,449 --> 00:13:16,269
was a lot of fun and very

341
00:13:20,549 --> 00:13:18,459
interdisciplinary so as you mentioned

342
00:13:22,829 --> 00:13:20,559
Alexis having this ability to talk to

343
00:13:23,970 --> 00:13:22,839
people that you're not and on topics

344
00:13:26,970 --> 00:13:23,980
that you're not an expert into can

345
00:13:28,559 --> 00:13:26,980
inform your personal science is one very

346
00:13:31,439 --> 00:13:28,569
rewarding and two extremely stimulating

347
00:13:33,900 --> 00:13:31,449
intellectually so this brings us perhaps

348
00:13:35,269 --> 00:13:33,910
a good place to transition to RPL right

349
00:13:38,609 --> 00:13:35,279
which is a very interdisciplinary

350
00:13:41,759 --> 00:13:38,619
collaborative that you lead perhaps can

351
00:13:47,220 --> 00:13:41,769
tell us a little bit what RPL is and and

352
00:13:49,439 --> 00:13:47,230
and how it came about yeah so RPL Rock

353
00:13:51,299 --> 00:13:49,449
powered life that's the name of our team

354
00:13:53,129 --> 00:13:51,309
and we've enjoyed that name it really

355
00:13:55,619 --> 00:13:53,139
works well as an umbrella under which we

356
00:13:57,119 --> 00:13:55,629
work sand Roya speaking here's also a

357
00:13:59,369 --> 00:13:57,129
member of our p.m. we're really proud

358
00:14:00,600 --> 00:13:59,379
and happy that he was willing to join us

359
00:14:04,470 --> 00:14:00,610
back at that time when we were

360
00:14:06,540 --> 00:14:04,480
conceiving this and and it's interesting

361
00:14:08,280 --> 00:14:06,550
to over time between what you are you

362
00:14:10,230 --> 00:14:08,290
proposed what your going to be and what

363
00:14:12,499 --> 00:14:10,240

you become I'll pretty much speak to

364
00:14:16,619 --> 00:14:12,509
what I think we are right now so

365
00:14:18,179 --> 00:14:16,629
collectively the PI's and the students

366
00:14:20,879 --> 00:14:18,189
and the postdocs involved in this

367
00:14:24,150 --> 00:14:20,889
project are asking a lot of questions

368
00:14:27,210 --> 00:14:24,160
about how Rock hosted life functions and

369
00:14:29,160 --> 00:14:27,220
in particular the chemical and

370
00:14:31,619 --> 00:14:29,170
hydrological processes that give rise to

371
00:14:34,799 --> 00:14:31,629
the release of energy from the rock

372
00:14:37,410 --> 00:14:34,809
system and then how biology harnesses

373
00:14:38,910 --> 00:14:37,420
that energy and utilizes it and then the

374
00:14:42,299 --> 00:14:38,920
signals that are generated from that how

375
00:14:45,059 --> 00:14:42,309
we'd ever recognize it but we're really

376
00:14:47,879 --> 00:14:45,069
looking at systems where the rock is at

377
00:14:50,400 --> 00:14:47,889
the temperature of this room so there's

378
00:14:52,079 --> 00:14:50,410
a there's a you know a deep paradigm

379
00:14:54,509 --> 00:14:52,089
about looking at hydrothermal systems

380
00:14:57,239 --> 00:14:54,519
where we get most vigorous circulation

381
00:15:00,449 --> 00:14:57,249
of water through rocks and heated fluids

382
00:15:02,549 --> 00:15:00,459
that helped to liberate that energy

383
00:15:04,410 --> 00:15:02,559
sources like making gases such as

384
00:15:05,910 --> 00:15:04,420
hydrogen and methane and then we flushed

385
00:15:08,069 --> 00:15:05,920
them up into a different environment

386
00:15:10,519 --> 00:15:08,079
like an ocean environment where there's

387
00:15:13,019 --> 00:15:10,529
things that can be reacted with those

388
00:15:14,789 --> 00:15:13,029

gases hydrogen methane and oxidize them

389
00:15:17,819 --> 00:15:14,799
and that's often that's one of the most

390
00:15:19,319 --> 00:15:17,829
powerful forms of chemo trophic life is

391
00:15:21,960 --> 00:15:19,329
looking for those redox ingredients

392
00:15:24,179 --> 00:15:21,970
we're kind of taking a different angle

393
00:15:27,689 --> 00:15:24,189
on that saying that is one beautiful

394
00:15:28,230 --> 00:15:27,699
model and it is a model of where we find

395
00:15:30,030 --> 00:15:28,240
life on

396
00:15:33,000 --> 00:15:30,040
earthen in our solar system that blooms

397
00:15:35,730 --> 00:15:33,010
really big explosions of life activity

398
00:15:39,120 --> 00:15:35,740
along black smoker on the seafloor or a

399
00:15:42,329 --> 00:15:39,130
lost city system but there may well be

400
00:15:44,760 --> 00:15:42,339
pervasive life throughout the rock

401
00:15:47,610 --> 00:15:44,770
system anywhere water hazard or is

402
00:15:48,960 --> 00:15:47,620
traveling through it and it does not

403
00:15:51,570 --> 00:15:48,970
need to be actually at such high

404
00:15:53,310 --> 00:15:51,580
temperatures that there that there's a

405
00:15:55,230 --> 00:15:53,320
considerable amount of energy stored

406
00:15:57,150 --> 00:15:55,240
there and if there are pathways to

407
00:16:00,210 --> 00:15:57,160
release it there might be life that's

408
00:16:04,500 --> 00:16:00,220
utilizing it in low abundance but but it

409
00:16:07,500 --> 00:16:04,510
vast realms and so that question of how

410
00:16:09,449 --> 00:16:07,510
you measure those things detect them

411
00:16:12,269 --> 00:16:09,459
because they have been slower and at

412
00:16:15,810 --> 00:16:12,279
smaller abundances and amounts and

413
00:16:17,130 --> 00:16:15,820

capture those perturbations is one of

414
00:16:19,800 --> 00:16:17,140
the big challenges that we're tackling

415
00:16:21,060 --> 00:16:19,810
at the moment so fascinating and the

416
00:16:22,440 --> 00:16:21,070
reason why I joined the team is to does

417
00:16:24,090 --> 00:16:22,450
the questions are so interesting and

418
00:16:25,920 --> 00:16:24,100
look what's really cool here and I hope

419
00:16:28,920 --> 00:16:25,930
our viewers realize this is that we're

420
00:16:31,860 --> 00:16:28,930
these studies is exploring environments

421
00:16:36,000 --> 00:16:31,870
that completely detached from lights

422
00:16:38,730 --> 00:16:36,010
we're biology can live off what only

423
00:16:40,230 --> 00:16:38,740
rocks and water and that's it at

424
00:16:41,850 --> 00:16:40,240
temperatures that are similar to the

425
00:16:43,769 --> 00:16:41,860
environments here so they said this

426
00:16:46,050 --> 00:16:43,779
really begs the question that life is

427
00:16:48,420 --> 00:16:46,060
really not restricted to surface and to

428
00:16:50,510 --> 00:16:48,430
surface planetary environments what are

429
00:16:54,300 --> 00:16:50,520
your thoughts on life on other worlds

430
00:16:55,590 --> 00:16:54,310
well actually I have this prop this rock

431
00:16:56,910 --> 00:16:55,600
on my desk if you use it when I'm

432
00:16:58,710 --> 00:16:56,920
talking with students a lot so see if I

433
00:17:00,569 --> 00:16:58,720
can get it in the camera okay so here's

434
00:17:03,540 --> 00:17:00,579
a chunk of rock this one came from

435
00:17:04,980 --> 00:17:03,550
Wyoming we go to all sorts of places in

436
00:17:08,220 --> 00:17:04,990
the earth to find similar rocks which

437
00:17:10,020 --> 00:17:08,230
form are underneath our ocean floor but

438
00:17:12,900 --> 00:17:10,030

this kind of Iraq which is a pretty

439
00:17:15,540 --> 00:17:12,910
tight right here is you know should be

440
00:17:18,900 --> 00:17:15,550
present on many rocky bodies it's on

441
00:17:22,199 --> 00:17:18,910
Mars we have should find us in the core

442
00:17:24,840 --> 00:17:22,209
of or the sort of center of Europa and

443
00:17:28,049 --> 00:17:24,850
Enceladus at cetera so this rock type

444
00:17:29,790 --> 00:17:28,059
incredibly common but its subsurface

445
00:17:31,440 --> 00:17:29,800
like you're saying so few places on

446
00:17:33,540 --> 00:17:31,450
earth it has been pushed up to the

447
00:17:35,760 --> 00:17:33,550
surface and we can collect that but

448
00:17:38,010 --> 00:17:35,770
we're commonly looking for the life

449
00:17:40,860 --> 00:17:38,020
that's in it or fluids circulating

450
00:17:41,110 --> 00:17:40,870
through it on many other bodies and you

451
00:17:42,700 --> 00:17:41,120
know

452
00:17:43,990 --> 00:17:42,710
solar system and it doesn't have to be

453
00:17:46,270 --> 00:17:44,000
restricted to our solar system that's

454
00:17:48,520 --> 00:17:46,280
just where we're looking right now but

455
00:17:51,760 --> 00:17:48,530
yeah so this would be rock hosted life

456
00:17:54,250 --> 00:17:51,770
life living in this and the source of

457
00:17:56,920 --> 00:17:54,260
the energy would be derived from this

458
00:17:57,520 --> 00:17:56,930
rock either directly that's what we

459
00:17:59,830 --> 00:17:57,530
don't know

460
00:18:03,210 --> 00:17:59,840
literally pretend I want to sustain

461
00:18:06,490 --> 00:18:03,220
myself can i latch on to this thing and

462
00:18:08,380 --> 00:18:06,500
pull essentially electrons from that and

463
00:18:11,110 --> 00:18:08,390

use them to drive back do I need to walk

464
00:18:12,730 --> 00:18:11,120
circulate water through it and convert

465
00:18:15,430 --> 00:18:12,740
them into something like hydrogen or

466
00:18:17,350 --> 00:18:15,440
methane and then use it but there's a

467
00:18:20,530 --> 00:18:17,360
lot of interest in how that rock itself

468
00:18:22,540 --> 00:18:20,540
is sustaining biological activity in any

469
00:18:24,190 --> 00:18:22,550
system that water passes through that's

470
00:18:26,350 --> 00:18:24,200
the idea that you still need water so

471
00:18:27,910 --> 00:18:26,360
it's subsurface life but water must

472
00:18:29,620 --> 00:18:27,920
migrate through the rock if there's no

473
00:18:33,880 --> 00:18:29,630
water movement then there's no life

474
00:18:35,560 --> 00:18:33,890
activity so so so cool so you mentioned

475
00:18:37,810 --> 00:18:35,570
a do these rocks are indeed form in the

476
00:18:40,419 --> 00:18:37,820
subsurface but because of earth being

477
00:18:42,190 --> 00:18:40,429
very dynamic tectonic lee so the plates

478
00:18:44,530 --> 00:18:42,200
are moving and pushing rocks up and down

479
00:18:46,570 --> 00:18:44,540
in some areas of the world this type of

480
00:18:48,669 --> 00:18:46,580
rock is actually abducted onto the

481
00:18:51,070 --> 00:18:48,679
surface for scientists to study I know

482
00:18:53,110 --> 00:18:51,080
you do you do field work as well and

483
00:18:54,460 --> 00:18:53,120
perhaps could describe where on earth

484
00:18:56,130 --> 00:18:54,470
these rocks are found and your

485
00:18:57,760 --> 00:18:56,140
experience when you visit those rocks

486
00:18:59,860 --> 00:18:57,770
yeah

487
00:19:06,160 --> 00:18:59,870
so you started very geological they're

488
00:19:12,640 --> 00:19:06,170

saying abducted shoved up on land you

489
00:19:15,850 --> 00:19:12,650
just got caught but well so one classic

490
00:19:17,320 --> 00:19:15,860
thing about geologists is you can

491
00:19:19,810 --> 00:19:17,330
usually study a lot of things in your

492
00:19:21,880 --> 00:19:19,820
backyard and we tend not to so if you're

493
00:19:23,860 --> 00:19:21,890
an American you go to Australia or New

494
00:19:26,440 --> 00:19:23,870
Zealand if you're Australian you go to

495
00:19:28,419 --> 00:19:26,450
China and if you're in China you go over

496
00:19:30,370 --> 00:19:28,429
to Afghanistan and everyone moves to

497
00:19:33,880 --> 00:19:30,380
different locations for a good reason to

498
00:19:35,500 --> 00:19:33,890
go to these other environments so like I

499
00:19:36,850 --> 00:19:35,510
said there's here's a rock from Wyoming

500
00:19:39,460 --> 00:19:36,860
but I'm not actually studying the rock

501
00:19:41,140 --> 00:19:39,470
from Wyoming I have to admit we we have

502
00:19:43,299 --> 00:19:41,150
many colleagues working in California

503
00:19:45,280 --> 00:19:43,309
so in RPL and in like the life

504
00:19:46,810 --> 00:19:45,290
underground in AI for example a lot of

505
00:19:49,000 --> 00:19:46,820
places in California where they're small

506
00:19:50,680 --> 00:19:49,010
slivers of this rock that are near the

507
00:19:51,720 --> 00:19:50,690
land surface I think you say enjoyed

508
00:19:57,390 --> 00:19:51,730
worked

509
00:19:59,190 --> 00:19:57,400
but for a second yeah thank you come on

510
00:20:00,870 --> 00:19:59,200
trying to say Cedars but it's like so

511
00:20:04,550 --> 00:20:00,880
you've been working over at chroma at

512
00:20:07,530 --> 00:20:04,560
the moment in the California coast range

513
00:20:10,020 --> 00:20:07,540

for the pot then we have many members of

514
00:20:12,060 --> 00:20:10,030
our PIL working at the Atlantis Massif

515
00:20:14,670 --> 00:20:12,070
so they've been on active cruises in the

516
00:20:17,550 --> 00:20:14,680
time of our our nai at along the

517
00:20:19,110 --> 00:20:17,560
mid-atlantic region at lost city region

518
00:20:22,470 --> 00:20:19,120
and they're going to return there next

519
00:20:26,340 --> 00:20:22,480
year in the ocean it is on the ocean

520
00:20:27,870 --> 00:20:26,350
floor and then in my own research group

521
00:20:31,860 --> 00:20:27,880
and with several folks I'm collaborating

522
00:20:34,080 --> 00:20:31,870
with in the RPL team and beyond we are

523
00:20:36,690 --> 00:20:34,090
working extensively in Oman which is on

524
00:20:38,310 --> 00:20:36,700
the Arabian Peninsula so we've been

525
00:20:40,800 --> 00:20:38,320
there the last four years doing

526
00:20:43,230 --> 00:20:40,810
fieldwork and we have we're gearing up

527
00:20:45,900 --> 00:20:43,240
for a major drilling expedition or

528
00:20:47,100 --> 00:20:45,910
drilling activities this winter so

529
00:20:48,450 --> 00:20:47,110
everything we've been doing it's been

530
00:20:51,270 --> 00:20:48,460
building up towards the stage where

531
00:20:53,280 --> 00:20:51,280
we're going to drill into these types of

532
00:20:54,900 --> 00:20:53,290
rocks that are exposed on the near the

533
00:20:57,180 --> 00:20:54,910
land surface or at the land surface and

534
00:20:59,610 --> 00:20:57,190
go down about a half a kilometer and

535
00:21:01,710 --> 00:20:59,620
then be recovering both the rock and the

536
00:21:03,390 --> 00:21:01,720
fluids there and looking for signs of

537
00:21:05,250 --> 00:21:03,400
the chemical and biological activity

538
00:21:09,900 --> 00:21:05,260

that we're really interested in where

539
00:21:12,030 --> 00:21:09,910
exactly are you drilling so we it's it's

540
00:21:15,180 --> 00:21:12,040
about two hours from the capital of Oman

541
00:21:17,550 --> 00:21:15,190
which is in Muscat so it's a long way

542
00:21:19,620 --> 00:21:17,560
away but in many ways compared to where

543
00:21:21,840 --> 00:21:19,630
I've worked in the High Arctic and in

544
00:21:23,790 --> 00:21:21,850
Samoa places like that this is way

545
00:21:27,270 --> 00:21:23,800
easier to get to those all take me days

546
00:21:30,000 --> 00:21:27,280
to get even on-site to get to Oman you

547
00:21:32,040 --> 00:21:30,010
do 24 hours of brutal continuous flying

548
00:21:35,010 --> 00:21:32,050
but you do get to Muscat you're in a

549
00:21:37,490 --> 00:21:35,020
beautiful nice capital city you sleep a

550
00:21:40,200 --> 00:21:37,500
little bit and you drive two hours into

551
00:21:42,750 --> 00:21:40,210
mountains of peridotite so all of the

552
00:21:45,300 --> 00:21:42,760
landscape is this rock absolutely

553
00:21:46,740 --> 00:21:45,310
spectacularly gorgeous mountains of rock

554
00:21:49,140 --> 00:21:46,750
that normally would be deeper in the

555
00:21:51,180 --> 00:21:49,150
interior of the earth and when you're

556
00:21:54,210 --> 00:21:51,190
standing there it's a desert so it looks

557
00:21:55,710 --> 00:21:54,220
dry but if you there are existing wells

558
00:21:58,050 --> 00:21:55,720
where people have drilled in previously

559
00:22:00,990 --> 00:21:58,060
so in this area of the mountains you can

560
00:22:03,630 --> 00:22:01,000
go down a well and within about 15

561
00:22:04,640 --> 00:22:03,640
metres you hit water and that water

562
00:22:07,040 --> 00:22:04,650
extends down

563
00:22:08,990 --> 00:22:07,050

hundreds of meters in the subsurface in

564
00:22:13,910 --> 00:22:09,000
these kinds of rocks inside the

565
00:22:15,320 --> 00:22:13,920
prototype and how did a locals feel when

566
00:22:17,600 --> 00:22:15,330
you're they're drilling into rocks for

567
00:22:22,460 --> 00:22:17,610
not necessarily in foil because you're

568
00:22:24,470 --> 00:22:22,470
in Peninsula well every year is a little

569
00:22:25,910 --> 00:22:24,480
different we have a really lovely time I

570
00:22:29,240 --> 00:22:25,920
mean the friendliest people I've ever

571
00:22:31,580 --> 00:22:29,250
worked with they're so generous both we

572
00:22:33,650 --> 00:22:31,590
work with the Omani a Ministry of water

573
00:22:35,900 --> 00:22:33,660
and with the Omani Ministry of Mineral

574
00:22:37,790 --> 00:22:35,910
Resources and they always help support

575
00:22:39,200 --> 00:22:37,800
us in getting permitted and equipment we

576
00:22:41,720 --> 00:22:39,210
need and things like that

577
00:22:43,400 --> 00:22:41,730
we work on our own so we're not escorted

578
00:22:47,300 --> 00:22:43,410
out there where we're working around the

579
00:22:49,700 --> 00:22:47,310
town of Ibrahim on and again everyone in

580
00:22:52,430 --> 00:22:49,710
the town there that we've met in the

581
00:22:54,890 --> 00:22:52,440
neighboring villages very curious about

582
00:22:56,180 --> 00:22:54,900
why we're there what we're working on

583
00:22:58,400 --> 00:22:56,190
we have variable amounts of

584
00:23:00,740 --> 00:22:58,410
communication depending on our English

585
00:23:04,310 --> 00:23:00,750
Arabic interfacing that happens at

586
00:23:05,750 --> 00:23:04,320
different times but we go out into these

587
00:23:07,610 --> 00:23:05,760
areas where these wells are and it's

588
00:23:10,040 --> 00:23:07,620

publicly available and we're allowed to

589
00:23:11,570 --> 00:23:10,050
camp out there and the only thing that's

590
00:23:12,950 --> 00:23:11,580
kind of funny is if we stay too many

591
00:23:15,650 --> 00:23:12,960
days in one place they're just curious

592
00:23:18,290 --> 00:23:15,660
about why did we find something really

593
00:23:20,390 --> 00:23:18,300
cool and they're wondering you know what

594
00:23:21,830 --> 00:23:20,400
it is we're looking for so many people

595
00:23:23,360 --> 00:23:21,840
drive buying their trucks and they come

596
00:23:25,100 --> 00:23:23,370
by and they want to see what we're doing

597
00:23:27,380 --> 00:23:25,110
and they put their hands into the

598
00:23:30,830 --> 00:23:27,390
experiments and then the water and and

599
00:23:32,750 --> 00:23:30,840
try to understand why these Americans or

600
00:23:34,610 --> 00:23:32,760
French or Germans we have a whole you

601
00:23:37,220 --> 00:23:34,620
know people coming from all over are so

602
00:23:38,690 --> 00:23:37,230
interested in their water so that's

603
00:23:42,320 --> 00:23:38,700
always a funny discussion to have with

604
00:23:43,850 --> 00:23:42,330
them but they're always so friendly so I

605
00:23:47,600 --> 00:23:43,860
absolutely love working down there

606
00:23:48,830 --> 00:23:47,610
that's so cool and so I'm gonna move the

607
00:23:50,840 --> 00:23:48,840
conversation a little bit away from your

608
00:23:52,820 --> 00:23:50,850
science and on to you because you're

609
00:23:54,530 --> 00:23:52,830
pretty an awesome person believe it or

610
00:23:55,820 --> 00:23:54,540
not and and the reason I say that is

611
00:23:59,620 --> 00:23:55,830
because not only you're a fantastic

612
00:24:02,360 --> 00:23:59,630
scientist but you also lead a team of

613
00:24:04,400 --> 00:24:02,370

scientists from all over the the nation

614
00:24:06,290 --> 00:24:04,410
or even the world and your professor

615
00:24:08,090 --> 00:24:06,300
mentoring graduate students and you have

616
00:24:11,450 --> 00:24:08,100
a family you're a mom how do you juggle

617
00:24:13,940 --> 00:24:11,460
all these things together well you

618
00:24:17,060 --> 00:24:13,950
should ask different people I would say

619
00:24:20,660 --> 00:24:17,070
I'm very very successful in juggling

620
00:24:22,520 --> 00:24:20,670
so I go I ride rollercoasters what I'm

621
00:24:25,520 --> 00:24:22,530
succeeding at managing in which things

622
00:24:27,530 --> 00:24:25,530
are dangling on the side and not getting

623
00:24:28,880 --> 00:24:27,540
the attention they deserve so it

624
00:24:31,100 --> 00:24:28,890
requires a lot of goodwill of the people

625
00:24:33,560 --> 00:24:31,110
you work with and patience because I

626
00:24:34,970 --> 00:24:33,570
have bitten off a lot and I love the

627
00:24:36,590 --> 00:24:34,980
people I'm working with and all the

628
00:24:38,570 --> 00:24:36,600
different projects that we're doing but

629
00:24:40,970 --> 00:24:38,580
they kind of have to each rotate to the

630
00:24:42,200 --> 00:24:40,980
forefront at different times depending

631
00:24:44,480 --> 00:24:42,210
on their needs

632
00:24:47,450 --> 00:24:44,490
there's also the Siq lissa t of teaching

633
00:24:51,950 --> 00:24:47,460
and fieldwork and research travel and so

634
00:24:55,610 --> 00:24:51,960
again I really find like that my focus

635
00:24:58,430 --> 00:24:55,620
has to keep shifting on what is the

636
00:24:59,720 --> 00:24:58,440
priority at that time or again with

637
00:25:01,730 --> 00:24:59,730
students if new students are coming in

638
00:25:04,430 --> 00:25:01,740

or graduating and this is where people

639
00:25:05,930 --> 00:25:04,440
need to really work well in teams not be

640
00:25:09,140 --> 00:25:05,940
alone if any one person was just

641
00:25:10,970 --> 00:25:09,150
dependent on me for example that's

642
00:25:13,040 --> 00:25:10,980
dangerous we need to always have

643
00:25:15,320 --> 00:25:13,050
networks of people who can step in and

644
00:25:19,360 --> 00:25:15,330
contribute to what the overall mission

645
00:25:22,280 --> 00:25:19,370
is I think so on the work front it is

646
00:25:24,530 --> 00:25:22,290
always complex but I love it I mean I

647
00:25:26,450 --> 00:25:24,540
have a great job in it the and

648
00:25:29,090 --> 00:25:26,460
everything I'm doing I asked to do so I

649
00:25:30,950 --> 00:25:29,100
try to be careful about what I would I

650
00:25:32,720 --> 00:25:30,960
bite off at any moment in time now I

651
00:25:36,140 --> 00:25:32,730
kind of have a sense of what I can and

652
00:25:39,680 --> 00:25:36,150
can't get done with my family I'm very

653
00:25:44,030 --> 00:25:39,690
protective of that I my kids are 10 and

654
00:25:45,860 --> 00:25:44,040
12 now so they they were born around the

655
00:25:48,260 --> 00:25:45,870
time I was the end of a postdoc and

656
00:25:50,660 --> 00:25:48,270
beginning of a faculty member that's a

657
00:25:52,130 --> 00:25:50,670
tumultuous time of transitions but it's

658
00:25:53,750 --> 00:25:52,140
also a time where you're really

659
00:25:55,730 --> 00:25:53,760
resetting the structure of what your

660
00:26:00,290 --> 00:25:55,740
life would look like and I'm really glad

661
00:26:01,850 --> 00:26:00,300
that they were born then and and they've

662
00:26:03,770 --> 00:26:01,860
been so integral in the time I've been

663
00:26:06,950 --> 00:26:03,780

in Colorado to just the way I managed my

664
00:26:09,050 --> 00:26:06,960
whole life both at home and at work and

665
00:26:10,430 --> 00:26:09,060
and I love the fabric of that that

666
00:26:13,940 --> 00:26:10,440
there's the dynamics of the things I do

667
00:26:15,620 --> 00:26:13,950
with my family and and being at work and

668
00:26:18,140 --> 00:26:15,630
being part of the community that I'm a

669
00:26:20,750 --> 00:26:18,150
part of so but yeah it's a challenge

670
00:26:23,150 --> 00:26:20,760
that's for sure yet I can see the

671
00:26:28,130 --> 00:26:23,160
enthusiasm is out of the camera as you

672
00:26:29,510 --> 00:26:28,140
talk about so you know as I go to

673
00:26:29,900 --> 00:26:29,520
conferences I you know chat was a lot of

674
00:26:32,240 --> 00:26:29,910
people

675
00:26:34,040 --> 00:26:32,250
you do too and I've had the experiences

676
00:26:36,020 --> 00:26:34,050
were making particularly early career

677
00:26:38,390 --> 00:26:36,030
women scientists are concerned sometimes

678
00:26:40,730 --> 00:26:38,400
of a putting family were family first

679
00:26:42,320 --> 00:26:40,740
was career and if you've been very

680
00:26:45,050 --> 00:26:42,330
successful doing both that perhaps you

681
00:26:46,820 --> 00:26:45,060
could mention a few more words about how

682
00:26:48,890 --> 00:26:46,830
you had you how can you have a

683
00:26:52,970 --> 00:26:48,900
successful scientific career as a woman

684
00:26:54,830 --> 00:26:52,980
in addition to to raising a family yeah

685
00:26:57,320 --> 00:26:54,840
I wish there was a formula which

686
00:26:59,180 --> 00:26:57,330
definitely isn't and and I'm gonna

687
00:27:00,890 --> 00:26:59,190
broaden it beyond just women in

688
00:27:02,630 --> 00:27:00,900

something but but I'll come back to some

689
00:27:06,080 --> 00:27:02,640
of those challenges that come with it is

690
00:27:08,930 --> 00:27:06,090
that I think my overall philosophy is

691
00:27:10,490 --> 00:27:08,940
that at any moment in time the best

692
00:27:12,170 --> 00:27:10,500
thing that you could do is be committed

693
00:27:16,790 --> 00:27:12,180
and excited about what you're working on

694
00:27:18,800 --> 00:27:16,800
then and to not and not know necessarily

695
00:27:20,420 --> 00:27:18,810
what's coming next but if you're giving

696
00:27:23,480 --> 00:27:20,430
yourself to what you're working on in

697
00:27:25,280 --> 00:27:23,490
doing you can you'll find that there's

698
00:27:27,320 --> 00:27:25,290
paths and weird doors that open that

699
00:27:29,180 --> 00:27:27,330
keep adding up and allow you to go along

700
00:27:30,800 --> 00:27:29,190
so then you're sitting there and it's

701
00:27:32,060 --> 00:27:30,810
very hard in that framework to say when

702
00:27:34,580 --> 00:27:32,070
is the exact right time to have a family

703
00:27:36,590 --> 00:27:34,590
or how much time do i balance with them

704
00:27:38,360 --> 00:27:36,600
and so again as an individual you have

705
00:27:40,730 --> 00:27:38,370
to make the decision are you ready at

706
00:27:42,500 --> 00:27:40,740
that time to bring a child in the world

707
00:27:44,120 --> 00:27:42,510
or raise kids or do it and if you've got

708
00:27:46,880 --> 00:27:44,130
the will and the energy you'll find a

709
00:27:48,260 --> 00:27:46,890
way and so you can't let the external

710
00:27:49,910 --> 00:27:48,270
where I'll tell you what the right time

711
00:27:52,730 --> 00:27:49,920
is you need to know when you're ready to

712
00:27:54,260 --> 00:27:52,740
do that and what and dig in and it's

713
00:27:55,430 --> 00:27:54,270

gonna it's all of these things are

714
00:27:57,050 --> 00:27:55,440
always challenging but if you're

715
00:27:58,580 --> 00:27:57,060
committed to it and you're excited and

716
00:28:01,550 --> 00:27:58,590
that's what you want to do you'll find a

717
00:28:03,050 --> 00:28:01,560
way and so people know oh my gosh I'm

718
00:28:05,000 --> 00:28:03,060
just so not ready to have kids right now

719
00:28:06,440 --> 00:28:05,010
for example or don't want to or then

720
00:28:08,330 --> 00:28:06,450
that's cool alright and other people are

721
00:28:10,670 --> 00:28:08,340
just yearning inside to do it so do it

722
00:28:12,230 --> 00:28:10,680
and and there isn't a negative

723
00:28:14,030 --> 00:28:12,240
repercussion that will come back you're

724
00:28:16,190 --> 00:28:14,040
just gonna have to kind of keep

725
00:28:18,320 --> 00:28:16,200
scaffolding it and figuring out how to

726
00:28:21,680 --> 00:28:18,330
keep the pieces going of things that you

727
00:28:23,990 --> 00:28:21,690
care about I think on the far other end

728
00:28:26,030 --> 00:28:24,000
that I've seen just again with a lot of

729
00:28:29,450 --> 00:28:26,040
women of my age and you know I'm in my

730
00:28:31,310 --> 00:28:29,460
40s and who have stepped out in various

731
00:28:34,700 --> 00:28:31,320
ways that we're running careers in

732
00:28:37,520 --> 00:28:34,710
science education business is that um

733
00:28:39,950 --> 00:28:37,530
it's more challenging if you leave for

734
00:28:41,630 --> 00:28:39,960
many years I have to say that just watch

735
00:28:42,470 --> 00:28:41,640
I does seem to be more difficult if you

736
00:28:44,450 --> 00:28:42,480
full

737
00:28:45,919 --> 00:28:44,460
are not no longer connected to the

738
00:28:47,539 --> 00:28:45,929

communities and the things you're

739
00:28:49,220 --> 00:28:47,549
passionate about in your professional

740
00:28:50,990 --> 00:28:49,230
life so if there's just some way

741
00:28:53,450 --> 00:28:51,000
whatever that's not that there's a set

742
00:28:55,430 --> 00:28:53,460
scale but if you can find some fraction

743
00:28:56,870 --> 00:28:55,440
of your time energy that you can still

744
00:29:00,440 --> 00:28:56,880
commit professionally while you may be

745
00:29:03,020 --> 00:29:00,450
more focused at home and then rebalance

746
00:29:04,820 --> 00:29:03,030
these things through time that I think

747
00:29:07,159 --> 00:29:04,830
is another really healthy way to try and

748
00:29:09,190 --> 00:29:07,169
move forward and and and you need to

749
00:29:11,150 --> 00:29:09,200
just ask people for what you need and

750
00:29:12,830 --> 00:29:11,160
believe in what you're doing I think

751
00:29:14,780 --> 00:29:12,840
it's really easy to project that

752
00:29:16,370 --> 00:29:14,790
externally people are disapproving or

753
00:29:19,430 --> 00:29:16,380
expect something different of you and

754
00:29:20,690 --> 00:29:19,440
they really might not be thank you so

755
00:29:22,850 --> 00:29:20,700
much for sharing that Alex's this is

756
00:29:24,409 --> 00:29:22,860
really meaningful and and so we're gonna

757
00:29:25,760 --> 00:29:24,419
actually open it up for questions cuz

758
00:29:27,409 --> 00:29:25,770
we've been chatting half an hour I could

759
00:29:29,330 --> 00:29:27,419
chat with you for another five hours is

760
00:29:33,289 --> 00:29:29,340
about of a rough hard life on a life in

761
00:29:35,000 --> 00:29:33,299
general so our first question comes from

762
00:29:38,210 --> 00:29:35,010
Thomas sorry

763
00:29:40,130 --> 00:29:38,220

Suren Evans hi thorn who asks do you

764
00:29:42,560 --> 00:29:40,140
think we will ever run out of new things

765
00:29:45,770 --> 00:29:42,570
to discover in science I myself am an

766
00:29:47,390 --> 00:29:45,780
aspiring scientist and sixteen years old

767
00:29:52,039 --> 00:29:47,400
I'm glad you are connecting thorin is

768
00:29:55,669 --> 00:29:52,049
awesome right not possible it's not

769
00:29:57,650 --> 00:29:55,679
possible but to take it even do it like

770
00:29:58,850 --> 00:29:57,660
a smaller level one of the things I

771
00:30:01,010 --> 00:29:58,860
think about a lot when let's say a

772
00:30:02,780 --> 00:30:01,020
student or a postdoc or or myself

773
00:30:04,490 --> 00:30:02,790
someone's working on an idea they're

774
00:30:06,380 --> 00:30:04,500
really excited about and they sometimes

775
00:30:08,000 --> 00:30:06,390
can be stressed that like oh someone

776
00:30:10,340 --> 00:30:08,010
else is going to discover it or figure

777
00:30:11,600 --> 00:30:10,350
it out first or before them if that is

778
00:30:13,640 --> 00:30:11,610
something to celebrate because if you

779
00:30:15,020 --> 00:30:13,650
cared about that question and the answer

780
00:30:16,909 --> 00:30:15,030
comes out you're like yeah now we know

781
00:30:18,980 --> 00:30:16,919
this and then the next question opens up

782
00:30:21,260 --> 00:30:18,990
and there's always the next question

783
00:30:23,240 --> 00:30:21,270
beyond the one you're just focused on at

784
00:30:27,200 --> 00:30:23,250
that very moment in time are being asked

785
00:30:29,120 --> 00:30:27,210
so there is no limit on our curiosity

786
00:30:31,039 --> 00:30:29,130
and where we're going to go with it and

787
00:30:32,840 --> 00:30:31,049
so you just have to be excited about

788
00:30:36,350 --> 00:30:32,850

what we do learn so that it opens doors

789
00:30:37,789 --> 00:30:36,360
to new questions that's great answer and

790
00:30:39,740 --> 00:30:37,799
Thorin did that you'll realize that the

791
00:30:42,710 --> 00:30:39,750
more you know the more you realize you

792
00:30:47,150 --> 00:30:42,720
don't know it opens up a whole new doors

793
00:30:51,380 --> 00:30:47,160
of Investigation next question comes

794
00:30:53,060 --> 00:30:51,390
from Adam Smith hi Adam he asks what

795
00:30:55,520 --> 00:30:53,070
kind of techniques are used to measure

796
00:30:57,740 --> 00:30:55,530
very small quantities and

797
00:31:00,380 --> 00:30:57,750
of hydrogen production in rocks quite

798
00:31:02,540 --> 00:31:00,390
technical nice question it is technical

799
00:31:06,650 --> 00:31:02,550
and it's really difficult to do it's

800
00:31:08,810 --> 00:31:06,660
really difficult to do so actually the

801
00:31:11,300 --> 00:31:08,820
lab that Sanjaya has been hosted in the

802
00:31:13,490 --> 00:31:11,310
Tori holder is one of the frontier labs

803
00:31:15,890 --> 00:31:13,500
that tries to measure exceedingly small

804
00:31:18,200 --> 00:31:15,900
concentrations of hydrogen and they've

805
00:31:19,970 --> 00:31:18,210
been working in systems where they can

806
00:31:21,500 --> 00:31:19,980
tell it sort of held at the threshold of

807
00:31:24,710 --> 00:31:21,510
any of our abilities to detect it's

808
00:31:27,200 --> 00:31:24,720
there and they're using various forms of

809
00:31:29,090 --> 00:31:27,210
gas chromatography etc to measure it in

810
00:31:31,190 --> 00:31:29,100
the fluids but there's a lot of tricks

811
00:31:33,320 --> 00:31:31,200
to how you ever get the sample from

812
00:31:34,610 --> 00:31:33,330
which you want to detect something in it

813
00:31:36,110 --> 00:31:34,620

and this is a big challenge in

814
00:31:38,630 --> 00:31:36,120
astrobiology in general as all the ways

815
00:31:40,880 --> 00:31:38,640
we even acquire the samples that really

816
00:31:42,560 --> 00:31:40,890
might host the chemical species or the

817
00:31:46,910 --> 00:31:42,570
living entity that we're interested in

818
00:31:48,320 --> 00:31:46,920
in finding so we are in our lab very

819
00:31:50,780 --> 00:31:48,330
interested in the development of new

820
00:31:52,160 --> 00:31:50,790
sensors for hydrogen that you could

821
00:31:54,590 --> 00:31:52,170
maybe place in the environment and

822
00:31:56,690 --> 00:31:54,600
detect pulses to because it's transient

823
00:31:59,900 --> 00:31:56,700
it comes and it goes and it waxes and

824
00:32:02,150 --> 00:31:59,910
wanes which is often due to both geology

825
00:32:04,640 --> 00:32:02,160
generating it and biology consuming it

826
00:32:06,050 --> 00:32:04,650
and we want to see that and so the

827
00:32:09,380 --> 00:32:06,060
technology needs to come a lot further

828
00:32:10,670 --> 00:32:09,390
right now so is it already - in terms of

829
00:32:12,860 --> 00:32:10,680
discussion it's just a strong

830
00:32:15,230 --> 00:32:12,870
combination between like geologists and

831
00:32:17,330 --> 00:32:15,240
biologists and chemists and engineers to

832
00:32:19,100 --> 00:32:17,340
reach those those frontiers of science

833
00:32:20,720 --> 00:32:19,110
which is again the trademark of

834
00:32:24,380 --> 00:32:20,730
astrobiologists bring those disciplines

835
00:32:27,050 --> 00:32:24,390
together so Graham Lau I Graham asks the

836
00:32:29,390 --> 00:32:27,060
next question what's the coolest place

837
00:32:31,010 --> 00:32:29,400
you've ever been on the planet and if

838
00:32:34,670 --> 00:32:31,020

you could go anywhere new for fieldwork

839
00:32:36,320 --> 00:32:34,680
where would it be oh good question

840
00:32:39,860 --> 00:32:36,330
Graham so for those in the audience

841
00:32:43,190 --> 00:32:39,870
Graham is a doctor allow as a PhD

842
00:32:45,560 --> 00:32:43,200
student with me and we traveled together

843
00:32:47,060 --> 00:32:45,570
to the High Arctic and I actually

844
00:32:49,640 --> 00:32:47,070
absolutely absolutely love working in

845
00:32:51,260 --> 00:32:49,650
the Arabian Peninsula and in Oman but I

846
00:32:52,730 --> 00:32:51,270
don't think I've ever been anywhere like

847
00:32:54,530 --> 00:32:52,740
when we went to the Arctic which was

848
00:32:57,680 --> 00:32:54,540
about three years ago it was summer of

849
00:33:00,710 --> 00:32:57,690
2014 you are so alone in this absolutely

850
00:33:03,170 --> 00:33:00,720
beautiful landscape and even trying to

851
00:33:04,520 --> 00:33:03,180
understand what's happening hidden

852
00:33:07,190 --> 00:33:04,530
underneath the surface because it's

853
00:33:08,810 --> 00:33:07,200
again it's an icy landscape but there's

854
00:33:10,580 --> 00:33:08,820
a lot going on

855
00:33:11,990 --> 00:33:10,590
underneath what we can see well or if

856
00:33:14,799 --> 00:33:12,000
you can even get the images from space

857
00:33:17,690 --> 00:33:14,809
versus helicopter versus on on foot so

858
00:33:19,220 --> 00:33:17,700
in many ways I would I would really love

859
00:33:22,419 --> 00:33:19,230
to go back there I've been given chances

860
00:33:26,810 --> 00:33:22,429
to go to Antarctica and I've never gone

861
00:33:29,210 --> 00:33:26,820
but I so I have to put the High Arctic

862
00:33:32,389 --> 00:33:29,220
is number one for where I've been I did

863
00:33:33,470 --> 00:33:32,399

used to dive a lot in the deep ocean so

864
00:33:36,499 --> 00:33:33,480
I used to go down on underwater

865
00:33:39,200 --> 00:33:36,509
volcanoes in submersibles and the

866
00:33:40,700 --> 00:33:39,210
technology the idea of being able to go

867
00:33:42,619 --> 00:33:40,710
to some of the deepest parts of the

868
00:33:44,389 --> 00:33:42,629
ocean floor when the technology's there

869
00:33:47,299 --> 00:33:44,399
you can't send humans down yet you got

870
00:33:49,190 --> 00:33:47,309
to put an ROV down there that would be

871
00:33:51,259 --> 00:33:49,200
really exciting if I could go one place

872
00:33:53,990 --> 00:33:51,269
I think I'd like to go even deeper than

873
00:33:56,930 --> 00:33:54,000
I ever went before so you took a

874
00:33:59,720 --> 00:33:56,940
submarine and went a few miles under the

875
00:34:02,060 --> 00:33:59,730
surface of the ocean to those to those

876
00:34:03,409 --> 00:34:02,070
underwater volcanoes what does it feel

877
00:34:05,960 --> 00:34:03,419
like when you're down there in this

878
00:34:07,610 --> 00:34:05,970
protective sphere of titanium like what

879
00:34:12,129 --> 00:34:07,620
you what goes through your mind you're

880
00:34:14,540 --> 00:34:12,139
essentially on another planet yeah so

881
00:34:16,040 --> 00:34:14,550
what I found interesting about Jay

882
00:34:17,569 --> 00:34:16,050
Knight we could only go with the

883
00:34:19,639 --> 00:34:17,579
submersible we were in we could only go

884
00:34:20,930 --> 00:34:19,649
up to 2 kilometers deep that says that

885
00:34:22,819 --> 00:34:20,940
was what it was pressure rated and this

886
00:34:24,919 --> 00:34:22,829
is off of Hawaii and in Samoa

887
00:34:27,829 --> 00:34:24,929
so these underwater volcanoes on a hot

888
00:34:29,480 --> 00:34:27,839

spot chain and we would dive down the

889
00:34:31,129 --> 00:34:29,490
flanks as far as we can go but they keep

890
00:34:32,750 --> 00:34:31,139
going deeper and deeper so we always had

891
00:34:34,579 --> 00:34:32,760
to send our Ovie's down to the five

892
00:34:36,559 --> 00:34:34,589
kilometre sites to get samples and we

893
00:34:38,419 --> 00:34:36,569
could only as humans go to - and you

894
00:34:40,970 --> 00:34:38,429
could go outside around and you could go

895
00:34:43,430 --> 00:34:40,980
in but you can't tell where you're at

896
00:34:45,109 --> 00:34:43,440
you get dropped in and it goes light you

897
00:34:47,359 --> 00:34:45,119
know you're in the photic zone and then

898
00:34:49,460 --> 00:34:47,369
it goes dark and then you have to

899
00:34:50,930 --> 00:34:49,470
imagine you're lying on your side curled

900
00:34:54,530 --> 00:34:50,940
into a little ball your faces around

901
00:34:56,270 --> 00:34:54,540
something this big and you're the pilots

902
00:34:58,280 --> 00:34:56,280
going and you basically feel like you're

903
00:35:00,589 --> 00:34:58,290
you're crawling through the darkness

904
00:35:02,480 --> 00:35:00,599
with a tiny flashlight and you can only

905
00:35:05,120 --> 00:35:02,490
see what the flash light illuminates as

906
00:35:07,130 --> 00:35:05,130
you go by so your perspective is not

907
00:35:08,240 --> 00:35:07,140
that great but you're but you have that

908
00:35:10,359 --> 00:35:08,250
sense like you're saying you're in this

909
00:35:13,099 --> 00:35:10,369
sphere and you're just kind of hanging

910
00:35:15,650 --> 00:35:13,109
in there and you're going by like vents

911
00:35:18,109 --> 00:35:15,660
coming up and strange things walking by

912
00:35:19,460 --> 00:35:18,119
so it's it's a very interesting feeling

913
00:35:21,710 --> 00:35:19,470

I love being down but it's very

914
00:35:24,050 --> 00:35:21,720
physically debilitating at least for me

915
00:35:26,060 --> 00:35:24,060
so you're down there for eight hours and

916
00:35:27,230 --> 00:35:26,070
then the co2 builds up and you're

917
00:35:28,790 --> 00:35:27,240
getting start getting a headache and

918
00:35:32,240 --> 00:35:28,800
then when you get sent up to the surface

919
00:35:36,140 --> 00:35:32,250
the temperatures rise from pretty chilly

920
00:35:37,490 --> 00:35:36,150
50s to 80s and I'm I travel a ton but

921
00:35:39,080 --> 00:35:37,500
I'm super motion sick and you're

922
00:35:41,630 --> 00:35:39,090
starting to get thrown all around in the

923
00:35:54,770 --> 00:35:41,640
top of the ocean and I just prayed for

924
00:35:56,390 --> 00:35:54,780
dear God that I went through pluck me

925
00:35:58,250 --> 00:35:56,400
out and put me on the deck of the ship

926
00:36:01,880 --> 00:35:58,260
and I would be dead for like six hours

927
00:36:03,800 --> 00:36:01,890
not able to move so it was cool but I I

928
00:36:06,680 --> 00:36:03,810
don't need to do it too many times in my

929
00:36:08,330 --> 00:36:06,690
life that sounds like just the purest

930
00:36:11,060 --> 00:36:08,340
form of exploration like really

931
00:36:17,270 --> 00:36:11,070
discovering new worlds and spacesuits

932
00:36:19,370 --> 00:36:17,280
essentially so get for sure yeah yeah so

933
00:36:20,930 --> 00:36:19,380
the next question is by Adam Robinson hi

934
00:36:23,780 --> 00:36:20,940
Adam we'll also ask a pretty technical

935
00:36:26,750 --> 00:36:23,790
question it's about the recent paper I'm

936
00:36:29,150 --> 00:36:26,760
where they're used for chlorates in the

937
00:36:32,150 --> 00:36:29,160
soil and variable and which essentially

938
00:36:33,710 --> 00:36:32,160

killed all the microbes which challenges

939
00:36:35,660 --> 00:36:33,720
a little bit the life on the surface of

940
00:36:38,120 --> 00:36:35,670
Mars so I guess what do you think of

941
00:36:44,240 --> 00:36:38,130
that paper and your thoughts on life on

942
00:36:46,099 --> 00:36:44,250
Mars that's a broad I'm not sure which

943
00:36:47,839 --> 00:36:46,109
of the papers that we're speaking at

944
00:36:50,990 --> 00:36:47,849
right now so I apologize for that but in

945
00:36:53,030 --> 00:36:51,000
general it's been incredibly fascinating

946
00:36:54,560 --> 00:36:53,040
learning more about the massive

947
00:36:57,260 --> 00:36:54,570
distribution of perchlorates on the

948
00:36:59,120 --> 00:36:57,270
surface of Mars the implications for

949
00:37:00,740 --> 00:36:59,130
what that means for detecting organics

950
00:37:02,690 --> 00:37:00,750
and signs of past life I mean it's

951
00:37:04,880 --> 00:37:02,700
really has an incredible effect on our

952
00:37:06,740 --> 00:37:04,890
technologies we use especially with

953
00:37:08,839 --> 00:37:06,750
combustion techniques to measure

954
00:37:11,240 --> 00:37:08,849
organics and the fact that perchlorate

955
00:37:12,980 --> 00:37:11,250
obliterates a lot of those signals yet

956
00:37:16,250 --> 00:37:12,990
how exciting that life can use

957
00:37:18,920 --> 00:37:16,260
perchlorate as an oxidant to breathe and

958
00:37:21,500 --> 00:37:18,930
it's there and and it must percolate and

959
00:37:24,589 --> 00:37:21,510
move anytime water or brines move

960
00:37:26,300 --> 00:37:24,599
through a system and it's going to be

961
00:37:29,780 --> 00:37:26,310
transferred into rocks that have

962
00:37:32,450 --> 00:37:29,790
reducing power and it's also going to be

963
00:37:34,400 --> 00:37:32,460

a interface that any methane being

964
00:37:37,460 --> 00:37:34,410
released on Mars must flux through

965
00:37:38,900 --> 00:37:37,470
so perchlorate is supremely fascinating

966
00:37:41,030 --> 00:37:38,910
in terms of its role that it may be

967
00:37:42,200 --> 00:37:41,040
playing in the both in the regulation of

968
00:37:44,690 --> 00:37:42,210
biology on Mars

969
00:37:47,000 --> 00:37:44,700
both destroying it and sustaining it and

970
00:37:49,880 --> 00:37:47,010
in that dichotomy is a very interesting

971
00:37:51,860 --> 00:37:49,890
one to explore so I find all the

972
00:37:53,930 --> 00:37:51,870
continuing papers and work on earth and

973
00:37:57,020 --> 00:37:53,940
else and on Mars about perchlorate

974
00:37:59,510 --> 00:37:57,030
really interesting but I don't have a

975
00:38:02,080 --> 00:37:59,520
specific comment on the paper that

976
00:38:06,320 --> 00:38:04,430
geoscientists your expertise in

977
00:38:09,290 --> 00:38:06,330
chemistry becomes very important when

978
00:38:12,740 --> 00:38:09,300
understanding what would biology eat and

979
00:38:14,360 --> 00:38:12,750
feed off to survive right but you know

980
00:38:16,610 --> 00:38:14,370
the great thing to think about is we

981
00:38:19,850 --> 00:38:16,620
didn't know about perchlorate respiring

982
00:38:21,940 --> 00:38:19,860
organisms a few years ago so we keep

983
00:38:24,080 --> 00:38:21,950
learning about biological adaptations

984
00:38:27,170 --> 00:38:24,090
metabolisms ways of functioning we

985
00:38:28,730 --> 00:38:27,180
didn't suspect it often until the diet

986
00:38:30,530 --> 00:38:28,740
the history's often been that

987
00:38:32,600 --> 00:38:30,540
geologically are you chemically we go

988
00:38:33,770 --> 00:38:32,610

see we detect things in the environment

989
00:38:35,750 --> 00:38:33,780
and then we suddenly see their

990
00:38:37,250 --> 00:38:35,760
consumption or production and then we

991
00:38:39,050 --> 00:38:37,260
wonder if biology is playing a role in

992
00:38:40,960 --> 00:38:39,060
their cycling and this has happened with

993
00:38:44,360 --> 00:38:40,970
many different elements or compounds

994
00:38:46,100 --> 00:38:44,370
that are present in natural systems so

995
00:38:47,630 --> 00:38:46,110
do your chemistry often sets the

996
00:38:50,480 --> 00:38:47,640
framework and then we get the puzzle of

997
00:38:51,740 --> 00:38:50,490
how does biology do it and in that area

998
00:38:54,290 --> 00:38:51,750
of what we call environmental

999
00:38:55,850 --> 00:38:54,300
microbiology keeps growing rapidly and

1000
00:38:57,890 --> 00:38:55,860
it has huge implications for

1001
00:38:59,720 --> 00:38:57,900
astrobiology in our understanding of

1002
00:39:01,130 --> 00:38:59,730
what kind of life activity we're even

1003
00:39:03,320 --> 00:39:01,140
looking for in these different

1004
00:39:04,820 --> 00:39:03,330
environments all right almost feels like

1005
00:39:06,080 --> 00:39:04,830
humans are actually the extremophiles

1006
00:39:07,520 --> 00:39:06,090
right because we're comfortable in such

1007
00:39:09,440 --> 00:39:07,530
a narrow range of temperature pressure

1008
00:39:11,810 --> 00:39:09,450
head pH or as microbes can be

1009
00:39:15,050 --> 00:39:11,820
comfortable at these huge ranges of

1010
00:39:18,110 --> 00:39:15,060
environments so from the specific now we

1011
00:39:21,320 --> 00:39:18,120
go to the super broad gram again asks

1012
00:39:23,870 --> 00:39:21,330
what excites you the most about the near

1013
00:39:27,940 --> 00:39:23,880

future of astrobiology and geo biology

1014
00:39:31,550 --> 00:39:27,950
research wait say that again say enjoy

1015
00:39:33,110 --> 00:39:31,560
what excites you the most about near

1016
00:39:34,730 --> 00:39:33,120
future of astrobiology so where is the

1017
00:39:37,190 --> 00:39:34,740
field going and what really gets you

1018
00:39:39,050 --> 00:39:37,200
excited about it and and perhaps

1019
00:39:39,340 --> 00:39:39,060
focusing a little bit on geo biology as

1020
00:39:44,750 --> 00:39:39,350
well

1021
00:39:47,300 --> 00:39:44,760
mmm-hmm personally I think that the

1022
00:39:52,070 --> 00:39:47,310
potential for detecting again

1023
00:39:55,550 --> 00:39:52,080
forms of life new forms of life in new

1024
00:39:56,930 --> 00:39:55,560
metabolisms is huge and we're getting

1025
00:40:01,700 --> 00:39:56,940
new opportunities because we're starting

1026
00:40:03,890 --> 00:40:01,710
to probe systems with interesting

1027
00:40:05,960 --> 00:40:03,900
diversity of both the geology and the

1028
00:40:07,610 --> 00:40:05,970
complexity of how they function and the

1029
00:40:10,490 --> 00:40:07,620
biologists are getting really creative

1030
00:40:12,230 --> 00:40:10,500
about how to measure whether or not

1031
00:40:14,420 --> 00:40:12,240
there is any activity so there's these

1032
00:40:15,650 --> 00:40:14,430
different nano calorimetry methods that

1033
00:40:17,600 --> 00:40:15,660
are coming along it tells you a little

1034
00:40:19,730 --> 00:40:17,610
bit heats been generated and maybe

1035
00:40:21,800 --> 00:40:19,740
there's a metabolic reaction going on

1036
00:40:23,420 --> 00:40:21,810
we need sometimes the signals to tell us

1037
00:40:25,250 --> 00:40:23,430
there's is some kind of electrical or

1038
00:40:27,350 --> 00:40:25,260

chemical process going on that is driven

1039
00:40:30,380 --> 00:40:27,360
by life but then we that helps us to go

1040
00:40:32,830 --> 00:40:30,390
hunt and look for well what's mediating

1041
00:40:35,570 --> 00:40:32,840
it and it might not look like the

1042
00:40:38,660 --> 00:40:35,580
traditional sort of cellular physiology

1043
00:40:40,130 --> 00:40:38,670
that we've often been contemplating we

1044
00:40:41,900 --> 00:40:40,140
keep learning we when we learned about

1045
00:40:44,150 --> 00:40:41,910
things like nano wires in ways that

1046
00:40:46,460 --> 00:40:44,160
organisms transfer electrons and create

1047
00:40:49,580 --> 00:40:46,470
networks in the environment that changed

1048
00:40:52,850 --> 00:40:49,590
as a that changing sense of how biology

1049
00:40:55,520 --> 00:40:52,860
can be structured and functioned changes

1050
00:40:57,200 --> 00:40:55,530
what we look for in the rock or the

1051
00:40:58,220 --> 00:40:57,210
fluid environment which also changes how

1052
00:41:00,620 --> 00:40:58,230
we're going to look and what we're going

1053
00:41:02,270 --> 00:41:00,630
to look for in other planets so I feel

1054
00:41:04,730 --> 00:41:02,280
like there's this that's a really

1055
00:41:07,340 --> 00:41:04,740
exciting area of active discovery and on

1056
00:41:10,400 --> 00:41:07,350
the flip side the cool thing in

1057
00:41:11,930 --> 00:41:10,410
astrobiology is that it's there's the

1058
00:41:16,580 --> 00:41:11,940
potential to have it more deeply

1059
00:41:19,040 --> 00:41:16,590
embedded into mission design and for the

1060
00:41:21,200 --> 00:41:19,050
this next several decades for

1061
00:41:22,880 --> 00:41:21,210
astrobiologists to be very vocal and

1062
00:41:24,470 --> 00:41:22,890
play an active role in the science and

1063
00:41:27,680 --> 00:41:24,480

the objectives of what those missions

1064
00:41:29,240 --> 00:41:27,690
are and and really carefully

1065
00:41:31,580 --> 00:41:29,250
contemplating the data that's being

1066
00:41:34,010 --> 00:41:31,590
returned from them and looking at it

1067
00:41:35,480 --> 00:41:34,020
through a different lens and so I think

1068
00:41:38,000 --> 00:41:35,490
it's a really rich time of opportunity

1069
00:41:41,270 --> 00:41:38,010
in astrobiology but it does require a

1070
00:41:43,160 --> 00:41:41,280
lot of participation in understanding

1071
00:41:46,850 --> 00:41:43,170
the potential for different missions to

1072
00:41:48,800 --> 00:41:46,860
and and how they're structured so the

1073
00:41:51,470 --> 00:41:48,810
more the more that people can grow into

1074
00:41:53,030 --> 00:41:51,480
that the better yeah science is not only

1075
00:41:54,860 --> 00:41:53,040
in our labs during our things really

1076
00:41:57,710 --> 00:41:54,870
participating as a community to where

1077
00:41:59,900 --> 00:41:57,720
the the missions are going to go and

1078
00:42:00,490 --> 00:41:59,910
what future science will we will be

1079
00:42:02,230 --> 00:42:00,500
perfomed

1080
00:42:03,880 --> 00:42:02,240
so thanks for bringing that up the next

1081
00:42:06,580 --> 00:42:03,890
question is by Christina who asks this

1082
00:42:08,950 --> 00:42:06,590
excellent question do you think it is

1083
00:42:10,840 --> 00:42:08,960
definitely possible to already have two

1084
00:42:14,860 --> 00:42:10,850
kids and be in school for biology and

1085
00:42:18,610 --> 00:42:14,870
astrobiology and be successful yeah yeah

1086
00:42:22,000 --> 00:42:18,620
no response so I already have two kids

1087
00:42:25,540 --> 00:42:22,010
with me in school now yeah so they're

1088
00:42:27,160 --> 00:42:25,550

the interesting things I don't because

1089
00:42:28,630 --> 00:42:27,170
otherwise the sense would be that kids

1090
00:42:30,940 --> 00:42:28,640
were a hindrance in some way and they're

1091
00:42:32,350 --> 00:42:30,950
they're not I think whether people have

1092
00:42:34,840 --> 00:42:32,360
decide to have children or they have

1093
00:42:36,520 --> 00:42:34,850
other areas that they've chosen to

1094
00:42:39,670 --> 00:42:36,530
dedicate a part of their heart and their

1095
00:42:42,160 --> 00:42:39,680
time in their life that is really rich

1096
00:42:44,020 --> 00:42:42,170
it makes us the people that we are and

1097
00:42:46,150 --> 00:42:44,030
our perspectives we bring we need that

1098
00:42:48,310 --> 00:42:46,160
balance in there so there it's there's

1099
00:42:50,530 --> 00:42:48,320
no detriment they're taking away from it

1100
00:42:52,000 --> 00:42:50,540
all so I see I don't know how old you

1101
00:42:54,550 --> 00:42:52,010
are for example but I see students

1102
00:42:56,980 --> 00:42:54,560
people becoming students in every decade

1103
00:42:59,200 --> 00:42:56,990
of their life and what matters is more

1104
00:43:00,550 --> 00:42:59,210
that they're they're ready their mental

1105
00:43:02,140 --> 00:43:00,560
they want to put their energy towards

1106
00:43:04,150 --> 00:43:02,150
being trained in a certain area and

1107
00:43:05,920 --> 00:43:04,160
applying that training and their

1108
00:43:08,170 --> 00:43:05,930
creativity or their perspectives to

1109
00:43:09,850 --> 00:43:08,180
answering questions so say you're going

1110
00:43:11,650 --> 00:43:09,860
into astrobiology and you have some

1111
00:43:12,700 --> 00:43:11,660
astrobiology questions motivating you

1112
00:43:17,110 --> 00:43:12,710
and you're being trained in various

1113
00:43:19,060 --> 00:43:17,120

biological realms there there isn't I

1114
00:43:20,740 --> 00:43:19,070
think there's a sense often that there's

1115
00:43:24,640 --> 00:43:20,750
a timeframe things have to happen on a

1116
00:43:26,950 --> 00:43:24,650
certain rapidity or scale and and that I

1117
00:43:28,900 --> 00:43:26,960
have not seen be borne out that there

1118
00:43:32,230 --> 00:43:28,910
that things have to come in an order of

1119
00:43:34,030 --> 00:43:32,240
where how fast and when you meet each

1120
00:43:37,390 --> 00:43:34,040
career stage and when your family

1121
00:43:39,370 --> 00:43:37,400
integrates in so I think it's a lot more

1122
00:43:41,410 --> 00:43:39,380
about the preparedness and the energy

1123
00:43:43,540 --> 00:43:41,420
and what you can put out there yeah

1124
00:43:53,290 --> 00:43:43,550
so Cristina to summarize the answer it's

1125
00:43:54,640 --> 00:43:53,300
it's hell yeah of course astrologically

1126
00:43:56,830 --> 00:43:54,650
at least I find this is very

1127
00:43:58,210 --> 00:43:56,840
collaborative right so an Alexis was

1128
00:44:00,100 --> 00:43:58,220
mentioning in a bidding beginning the

1129
00:44:01,900 --> 00:44:00,110
value of having a peer network right

1130
00:44:05,020 --> 00:44:01,910
well none of us are in this alone right

1131
00:44:07,510 --> 00:44:05,030
we rely on our and our peers to push our

1132
00:44:08,860 --> 00:44:07,520
science up so you'll do the same and I

1133
00:44:12,070 --> 00:44:08,870
have no doubt you'll be very successful

1134
00:44:14,440 --> 00:44:12,080
the next question is by Mike and

1135
00:44:17,170 --> 00:44:14,450
Sheppard who was an undergraduate

1136
00:44:19,660 --> 00:44:17,180
and working on wanting to do graduate

1137
00:44:21,970 --> 00:44:19,670
school and he's I think from a small

1138
00:44:23,230 --> 00:44:21,980

small school MSU Denver and he was

1139
00:44:24,640 --> 00:44:23,240
struggling to get into graduate school

1140
00:44:26,050 --> 00:44:24,650
because it didn't have enough

1141
00:44:29,020 --> 00:44:26,060
independent research

1142
00:44:31,329 --> 00:44:29,030
I guess so what kind of advice would you

1143
00:44:32,770 --> 00:44:31,339
give to early couriers who are in

1144
00:44:34,150 --> 00:44:32,780
private smaller schools that already

1145
00:44:36,310 --> 00:44:34,160
have access to independent research who

1146
00:44:39,579 --> 00:44:36,320
want to go into research and and get a

1147
00:44:43,060 --> 00:44:39,589
PhD yeah that's a great question it's

1148
00:44:44,440 --> 00:44:43,070
challenging I mean one just get it

1149
00:44:46,240 --> 00:44:44,450
getting into graduate school is

1150
00:44:49,450 --> 00:44:46,250
challenging because programs aren't as

1151
00:44:52,990 --> 00:44:49,460
that large and there's a ton of students

1152
00:44:54,310 --> 00:44:53,000
interested in it and and then you're

1153
00:44:56,520 --> 00:44:54,320
asking the question about how to get the

1154
00:45:00,579 --> 00:44:56,530
independent research experiences and so

1155
00:45:03,130 --> 00:45:00,589
I really if your school doesn't offer

1156
00:45:04,870 --> 00:45:03,140
them really the best place is that there

1157
00:45:06,700 --> 00:45:04,880
are a lot of summer programs and it

1158
00:45:08,980 --> 00:45:06,710
takes some deep hunting for those and

1159
00:45:11,020 --> 00:45:08,990
then same thing taking graham for

1160
00:45:12,940 --> 00:45:11,030
example who is just completing his PhD

1161
00:45:14,800 --> 00:45:12,950
with me he had a lot of really

1162
00:45:16,540 --> 00:45:14,810
interesting experiences that he had he

1163
00:45:19,690 --> 00:45:16,550

was at York College in Pennsylvania but

1164
00:45:21,550 --> 00:45:19,700
he went elsewhere in both California and

1165
00:45:23,230 --> 00:45:21,560
in Rhode Island and elsewhere to find a

1166
00:45:25,300 --> 00:45:23,240
summer internship here and there and

1167
00:45:28,270 --> 00:45:25,310
each one of them might not be also

1168
00:45:30,430 --> 00:45:28,280
directly in an area you're specifically

1169
00:45:32,290 --> 00:45:30,440
want to study but a lot of the skills

1170
00:45:33,790 --> 00:45:32,300
you develop by just going and throwing

1171
00:45:37,319 --> 00:45:33,800
yourself into a research project that

1172
00:45:40,270 --> 00:45:37,329
maybe is mmm in another field but just

1173
00:45:41,740 --> 00:45:40,280
learning how to come in understand the

1174
00:45:45,430 --> 00:45:41,750
nature of the question how are you going

1175
00:45:47,589 --> 00:45:45,440
to figure out how to set up some

1176
00:45:49,900 --> 00:45:47,599
experiments or do calculations are they

1177
00:45:50,620 --> 00:45:49,910
to answer it to some degree evaluate how

1178
00:45:52,990 --> 00:45:50,630
well that went

1179
00:45:55,030 --> 00:45:53,000
that whole arc is really valuable and

1180
00:45:56,620 --> 00:45:55,040
it's valuable to do before you choose to

1181
00:45:59,589 --> 00:45:56,630
go to graduate school to to see how much

1182
00:46:01,420 --> 00:45:59,599
you really want to do that so I do

1183
00:46:03,370 --> 00:46:01,430
suggest getting them there's a reason

1184
00:46:04,990 --> 00:46:03,380
people want to see the independent

1185
00:46:06,670 --> 00:46:05,000
research experiences before school

1186
00:46:08,170 --> 00:46:06,680
because it helps to really get a sense

1187
00:46:10,990 --> 00:46:08,180
to of the commitment of the student to

1188
00:46:12,460 --> 00:46:11,000

follow through but you might often need

1189
00:46:14,440 --> 00:46:12,470
to look well beyond the borders of your

1190
00:46:15,940 --> 00:46:14,450
school and go beyond the borders of your

1191
00:46:18,520 --> 00:46:15,950
specific interests and just throw

1192
00:46:20,349 --> 00:46:18,530
yourself in much like when you go in the

1193
00:46:22,599 --> 00:46:20,359
workforce a lot of times just get a job

1194
00:46:24,370 --> 00:46:22,609
and start learning to work and commit to

1195
00:46:26,710 --> 00:46:24,380
the organization here and then learn how

1196
00:46:27,259 --> 00:46:26,720
it functions and then realize over time

1197
00:46:28,849 --> 00:46:27,269
what are you

1198
00:46:31,399 --> 00:46:28,859
specific skills and you need to shift

1199
00:46:32,689 --> 00:46:31,409
directions you know not everything's

1200
00:46:35,149 --> 00:46:32,699
about academia and that's really

1201
00:46:36,799 --> 00:46:35,159
important actually the other thing I'd

1202
00:46:39,079 --> 00:46:36,809
say in all this is don't be discouraged

1203
00:46:41,209 --> 00:46:39,089
if you need to go work for a few years I

1204
00:46:41,929 --> 00:46:41,219
think working after undergraduate in any

1205
00:46:44,899 --> 00:46:41,939
capacity

1206
00:46:46,339 --> 00:46:44,909
job is really healthy and makes you

1207
00:46:49,669 --> 00:46:46,349
think hard about if you go back to

1208
00:46:51,199 --> 00:46:49,679
school why what do you want to do and

1209
00:46:53,239 --> 00:46:51,209
gives you a lot of valuable skills you

1210
00:46:54,739 --> 00:46:53,249
could apply to back in school if you

1211
00:46:57,739 --> 00:46:54,749
need them or do a different job as you

1212
00:47:01,729 --> 00:46:57,749
realize what the ways that you can grow

1213
00:47:03,889 --> 00:47:01,739

so I think worry the the direct path

1214
00:47:06,739 --> 00:47:03,899
right from undergrad to grad is actually

1215
00:47:10,880 --> 00:47:06,749
something to ponder for anybody I'm not

1216
00:47:12,649 --> 00:47:10,890
talking just to you there's a lot of

1217
00:47:16,219 --> 00:47:12,659
different ways and there you do not have

1218
00:47:18,319 --> 00:47:16,229
to be 20 to 23 or 24 to start graduate

1219
00:47:19,699 --> 00:47:18,329
school and be fine starting in at 30

1220
00:47:23,299 --> 00:47:19,709
there's lots there's lots of good

1221
00:47:25,489 --> 00:47:23,309
reasons to do that - thanks for that

1222
00:47:27,529 --> 00:47:25,499
Alex and also don't feel shy about Cole

1223
00:47:28,789 --> 00:47:27,539
contacting professors at different

1224
00:47:30,889 --> 00:47:28,799
institutions to see if they have

1225
00:47:33,049 --> 00:47:30,899
possibilities of a summer internship you

1226
00:47:34,939 --> 00:47:33,059
know and so I mean this happened to me I

1227
00:47:36,679 --> 00:47:34,949
had a student contact me from New York

1228
00:47:38,779 --> 00:47:36,689
Colorado out of all places about wanting

1229
00:47:40,579 --> 00:47:38,789
to work with me and and the email was

1230
00:47:42,589 --> 00:47:40,589
really well-crafted very professional we

1231
00:47:43,909 --> 00:47:42,599
had a phone call and now for the second

1232
00:47:46,699 --> 00:47:43,919
summer in a row she's in my lap so

1233
00:47:48,349 --> 00:47:46,709
there's a lot of value in putting

1234
00:47:50,059 --> 00:47:48,359
yourself out there like Alexis mentioned

1235
00:47:51,739 --> 00:47:50,069
in terms of finding the research

1236
00:47:53,779 --> 00:47:51,749
opportunities somebody take this take

1237
00:47:57,559 --> 00:47:53,789
some research as well you're thinking

1238
00:47:59,629 --> 00:47:57,569

about shaylen right yes and so just to

1239
00:48:01,579 --> 00:47:59,639
admit my for anyone out there that gets

1240
00:48:03,109 --> 00:48:01,589
discouraged so I feel really bad shaylen

1241
00:48:05,809 --> 00:48:03,119
wrote to me lots of times and I didn't

1242
00:48:07,279 --> 00:48:05,819
write her back she did work with Sanjoy

1243
00:48:08,659 --> 00:48:07,289
she came here and I met her and she's

1244
00:48:10,370 --> 00:48:08,669
wonderful and then she found another

1245
00:48:12,469 --> 00:48:10,380
faculty member she did some great

1246
00:48:14,059 --> 00:48:12,479
research here with him and I think the

1247
00:48:16,249 --> 00:48:14,069
perseverance of just putting yourself

1248
00:48:19,699 --> 00:48:16,259
out there and talking about what you'd

1249
00:48:21,769 --> 00:48:19,709
like to do you'll find weird connections

1250
00:48:23,839 --> 00:48:21,779
of how you can find a home in that and

1251
00:48:25,669 --> 00:48:23,849
don't be discouraged if there's people

1252
00:48:31,489 --> 00:48:25,679
who are being bad like me and having

1253
00:48:33,259 --> 00:48:31,499
made me back the next question is from

1254
00:48:34,789 --> 00:48:33,269
Graham and I'm gonna ask you cut your

1255
00:48:36,979 --> 00:48:34,799
your question Graham in a second but I

1256
00:48:38,899 --> 00:48:36,989
wanted to touch a little bit Alexis

1257
00:48:40,640 --> 00:48:38,909
about your your experience in a High

1258
00:48:43,670 --> 00:48:40,650
Arctic also because that sounded really

1259
00:48:44,870 --> 00:48:43,680
interesting I was also transfixed when

1260
00:48:46,670 --> 00:48:44,880
you described your experiences and

1261
00:48:47,960 --> 00:48:46,680
something in the submersible what's kind

1262
00:48:50,029 --> 00:48:47,970
of picturing it in my mind when you look

1263
00:48:52,370 --> 00:48:50,039

like it was a great movie a great image

1264
00:48:53,839 --> 00:48:52,380
um so what brought you to the High

1265
00:48:56,299 --> 00:48:53,849
Arctic in the first place what kind of

1266
00:48:58,970 --> 00:48:56,309
biology is there and then I guess I want

1267
00:49:00,799 --> 00:48:58,980
to also touch your senses what do you

1268
00:49:06,370 --> 00:49:00,809
see what you smell what you hear when

1269
00:49:08,630 --> 00:49:06,380
you're in these extreme environments so

1270
00:49:12,289 --> 00:49:08,640
when I first came to the University of

1271
00:49:15,470 --> 00:49:12,299
Colorado I had the joy of interacting

1272
00:49:18,140 --> 00:49:15,480
with Bob Pappalardo who is now the lead

1273
00:49:21,890 --> 00:49:18,150
for the Europa multiple flyby mission or

1274
00:49:25,339 --> 00:49:21,900
clipper and we co-advised our first PhD

1275
00:49:27,740 --> 00:49:25,349
student together and she was working on

1276
00:49:32,029 --> 00:49:27,750
a project in the High Arctic at a place

1277
00:49:33,890 --> 00:49:32,039
called board pass and we over the last

1278
00:49:35,690 --> 00:49:33,900
decade of continuing to grow the

1279
00:49:37,670 --> 00:49:35,700
research there so Graham who's been

1280
00:49:38,990 --> 00:49:37,680
asking some questions is integral part

1281
00:49:39,380 --> 00:49:39,000
of work we're doing up in the High

1282
00:49:42,319 --> 00:49:39,390
Arctic

1283
00:49:43,760 --> 00:49:42,329
I hadn't been myself nor had Graham that

1284
00:49:45,769 --> 00:49:43,770
was doing it so this is our first trip

1285
00:49:50,990 --> 00:49:45,779
up there but we were going up there

1286
00:49:54,019 --> 00:49:51,000
because there is a system up there of

1287
00:49:55,609 --> 00:49:54,029
where the ice is covered in minerals and

1288
00:49:57,799 --> 00:49:55,619

the minerals are elemental sulfur and

1289
00:50:00,829 --> 00:49:57,809
you can see these yellow sulfur deposits

1290
00:50:02,180 --> 00:50:00,839
from space and they're anomalous it's

1291
00:50:04,849 --> 00:50:02,190
the only place on earth where we see

1292
00:50:06,380 --> 00:50:04,859
them and they really shouldn't be there

1293
00:50:08,450 --> 00:50:06,390
they shouldn't persist there shouldn't

1294
00:50:10,370 --> 00:50:08,460
be chemically stable so there's a

1295
00:50:11,809 --> 00:50:10,380
question of where'd they come from how

1296
00:50:14,240 --> 00:50:11,819
are they forming and why are they still

1297
00:50:15,980 --> 00:50:14,250
persisting and we had many hypotheses

1298
00:50:17,859 --> 00:50:15,990
that biology was playing a role in both

1299
00:50:20,510 --> 00:50:17,869
their formation and then there and then

1300
00:50:22,220 --> 00:50:20,520
capturing and maintaining them there and

1301
00:50:24,380 --> 00:50:22,230
the only way to test that we've done a

1302
00:50:27,230 --> 00:50:24,390
lot of remote sensing data and from

1303
00:50:29,660 --> 00:50:27,240
different orbital scales we needed to do

1304
00:50:32,150 --> 00:50:29,670
the work in field and look for the

1305
00:50:35,000 --> 00:50:32,160
origin of the minerals the fluids and

1306
00:50:37,730 --> 00:50:35,010
whether they're the what ways biology

1307
00:50:39,740 --> 00:50:37,740
was dynamically behaving so we were

1308
00:50:41,210 --> 00:50:39,750
really fortunate the exobiology program

1309
00:50:45,230 --> 00:50:41,220
funded us to go up there for a

1310
00:50:47,210 --> 00:50:45,240
three-week summer expedition and you

1311
00:50:48,980 --> 00:50:47,220
travel three days up in ever smaller

1312
00:50:50,630 --> 00:50:48,990
planes and then you get on a small one

1313
00:50:52,010 --> 00:50:50,640

with your all your stuff for the three

1314
00:50:53,230 --> 00:50:52,020
weeks or the two more weeks you're going

1315
00:50:57,010 --> 00:50:53,240
to be up there

1316
00:50:58,960 --> 00:50:57,020
they drop you and say goodbye but we had

1317
00:51:00,580 --> 00:50:58,970
a helicopter that does a last bit and I

1318
00:51:01,900 --> 00:51:00,590
realize I love helicopters I never

1319
00:51:03,520 --> 00:51:01,910
guessed I would have liked helicopters

1320
00:51:05,260 --> 00:51:03,530
being motion sick but they're just

1321
00:51:06,970 --> 00:51:05,270
amazing you're up and you're flying down

1322
00:51:09,940 --> 00:51:06,980
around and just getting the glimpses in

1323
00:51:13,480 --> 00:51:09,950
our case of all this sulphur all over

1324
00:51:15,070 --> 00:51:13,490
the landscape so but you're up there in

1325
00:51:17,710 --> 00:51:15,080
an Arctic landscape you're hearing

1326
00:51:22,150 --> 00:51:17,720
glaciers pop and groan and rivers

1327
00:51:23,800 --> 00:51:22,160
roaring by ripping the both the ice and

1328
00:51:25,840 --> 00:51:23,810
the in the rock away you're pretty much

1329
00:51:27,670 --> 00:51:25,850
drinking dirt water most of the time

1330
00:51:29,050 --> 00:51:27,680
because it's all the salts other things

1331
00:51:31,510 --> 00:51:29,060
that are coming by and whatever

1332
00:51:33,580 --> 00:51:31,520
freeze-dried foods you can have we all

1333
00:51:34,960 --> 00:51:33,590
slept in our own tents because we all

1334
00:51:36,370 --> 00:51:34,970
smelled and we all wanted to be away

1335
00:51:38,200 --> 00:51:36,380
from each other so we're all just

1336
00:51:40,840 --> 00:51:38,210
littered on the landscape in different

1337
00:51:42,430 --> 00:51:40,850
places and every day you got up and you

1338
00:51:44,890 --> 00:51:42,440

got dressed and you put on your gear and

1339
00:51:46,750 --> 00:51:44,900
you walk the ice and we walked all over

1340
00:51:49,780 --> 00:51:46,760
that landscape I'm as much as we could

1341
00:51:51,160 --> 00:51:49,790
but it was that's that's definitely a

1342
00:51:52,630 --> 00:51:51,170
really beautiful place and you just

1343
00:51:56,740 --> 00:51:52,640
don't see anyone you don't even see

1344
00:51:58,420 --> 00:51:56,750
wildlife you're just alone that's just

1345
00:52:00,670 --> 00:51:58,430
so cool I wish I couldn't experience

1346
00:52:02,260 --> 00:52:00,680
that one day so we're running out of

1347
00:52:02,830 --> 00:52:02,270
time but I'm going to ask you one last

1348
00:52:06,420 --> 00:52:02,840
question

1349
00:52:08,590 --> 00:52:06,430
and and it it stems from Graham's

1350
00:52:10,870 --> 00:52:08,600
astrobiology is a very interdisciplinary

1351
00:52:12,490 --> 00:52:10,880
topic that attracts a lot of attention

1352
00:52:13,810 --> 00:52:12,500
from the public because he asks those

1353
00:52:15,099 --> 00:52:13,820
fundamental questions you know where do

1354
00:52:18,580 --> 00:52:15,109
we come for him where we're going is

1355
00:52:20,050 --> 00:52:18,590
this life further away from Earth and

1356
00:52:22,870 --> 00:52:20,060
what are your thoughts in the role of

1357
00:52:24,520 --> 00:52:22,880
astrobiology in connecting was the was

1358
00:52:30,849 --> 00:52:24,530
the public in terms of awareness of

1359
00:52:33,970 --> 00:52:30,859
science oh it's so powerful one of my

1360
00:52:36,700 --> 00:52:33,980
most fun experiences was going to a

1361
00:52:39,310 --> 00:52:36,710
fourth grade classroom a year ago and I

1362
00:52:40,420 --> 00:52:39,320
just brought a globe and I was talking a

1363
00:52:42,160 --> 00:52:40,430

little bit about the places I've worked

1364
00:52:43,780 --> 00:52:42,170
and travelled I said can you tell me

1365
00:52:46,720 --> 00:52:43,790
somewhere on earth where you don't think

1366
00:52:48,849 --> 00:52:46,730
there's life and and the kids are

1367
00:52:50,290 --> 00:52:48,859
sitting there and trying to imagine what

1368
00:52:51,910 --> 00:52:50,300
those places would be twitch you know if

1369
00:52:54,609 --> 00:52:51,920
let's pretend they say inside a volcano

1370
00:52:56,290 --> 00:52:54,619
or outside of it or here and then they

1371
00:52:59,470 --> 00:52:56,300
just naturally started to ask questions

1372
00:53:01,780 --> 00:52:59,480
about other salt bodies in our solar

1373
00:53:04,450 --> 00:53:01,790
system in other states of what

1374
00:53:05,620 --> 00:53:04,460
environment it could look like and and

1375
00:53:07,930 --> 00:53:05,630
the questions

1376
00:53:09,519 --> 00:53:07,940
just poured out of them I literally

1377
00:53:11,289 --> 00:53:09,529
needed five minutes with the globe and

1378
00:53:13,539 --> 00:53:11,299
then they talk the rest of the time and

1379
00:53:15,700 --> 00:53:13,549
I just redirected their questions and in

1380
00:53:19,779 --> 00:53:15,710
the rest so that's at the fourth grade

1381
00:53:22,630 --> 00:53:19,789
level but then if I talk with just any

1382
00:53:24,609 --> 00:53:22,640
family member or member the public about

1383
00:53:26,170 --> 00:53:24,619
the places we go and where we're

1384
00:53:27,789 --> 00:53:26,180
searching for water or what kind of

1385
00:53:30,880 --> 00:53:27,799
life-forms were searching for in the

1386
00:53:32,799 --> 00:53:30,890
waters their own imaginations capture

1387
00:53:35,499 --> 00:53:32,809
that and then run in very interesting

1388
00:53:38,620 --> 00:53:35,509

directions and with no scientific

1389
00:53:39,999 --> 00:53:38,630
training that can ask such pointed good

1390
00:53:40,930 --> 00:53:40,009
questions about things we don't have

1391
00:53:45,400 --> 00:53:40,940
answers to

1392
00:53:48,700 --> 00:53:45,410
and so astrobiology is really a potent

1393
00:53:51,819 --> 00:53:48,710
way of increasing people's both interest

1394
00:53:54,370 --> 00:53:51,829
and excitement about science and in all

1395
00:53:57,609 --> 00:53:54,380
the ways that can be applied so that's

1396
00:54:00,940 --> 00:53:57,619
really struck me over the years how how

1397
00:54:02,589 --> 00:54:00,950
powerful that is it's it's a this is

1398
00:54:04,029 --> 00:54:02,599
almost a very nice place to leave this

1399
00:54:05,920 --> 00:54:04,039
conversation but perhaps I would invite

1400
00:54:07,720 --> 00:54:05,930
you to if anything else you wanted to

1401
00:54:08,980 --> 00:54:07,730
add or some some advice for early career

1402
00:54:13,509 --> 00:54:08,990
scientists that we've not already

1403
00:54:17,109 --> 00:54:13,519
touched on oh that's a good question

1404
00:54:20,410 --> 00:54:17,119
I think it's just we're coming back

1405
00:54:23,799 --> 00:54:20,420
around to this sense of you it's really

1406
00:54:25,900 --> 00:54:23,809
hard to chart a path in these fields and

1407
00:54:30,519 --> 00:54:25,910
you shouldn't feel the pressure to I

1408
00:54:32,769 --> 00:54:30,529
think again what you want to be able to

1409
00:54:35,019 --> 00:54:32,779
do is as have a voice at any table

1410
00:54:36,160 --> 00:54:35,029
that's something that your ideas or

1411
00:54:38,079 --> 00:54:36,170
things you've been trained to do that

1412
00:54:40,509 --> 00:54:38,089
could contribute to the discussion you

1413
00:54:42,999 --> 00:54:40,519

do not need to be that master of all it

1414
00:54:45,670 --> 00:54:43,009
is too hard and you've got to be ok with

1415
00:54:46,150 --> 00:54:45,680
all the things you don't know I was

1416
00:54:51,150 --> 00:54:46,160
nervous

1417
00:54:53,589 --> 00:54:51,160
certain roles in astrobiology because

1418
00:54:56,380 --> 00:54:53,599
there's so much I don't even know about

1419
00:54:58,150 --> 00:54:56,390
within the field and yet on the other

1420
00:55:00,460 --> 00:54:58,160
hand when I go to any of these different

1421
00:55:02,680 --> 00:55:00,470
forms and they could be small meetings

1422
00:55:05,170 --> 00:55:02,690
to large conferences depends on what

1423
00:55:06,910 --> 00:55:05,180
we've been convened to do I realize that

1424
00:55:09,400 --> 00:55:06,920
I have a perspective and something to

1425
00:55:11,440 --> 00:55:09,410
contribute and say and and that can help

1426
00:55:13,240 --> 00:55:11,450
change the course of what we're trying

1427
00:55:17,150 --> 00:55:13,250
to do or how are doing it or why we're

1428
00:55:19,819 --> 00:55:17,160
doing it so take it in little bites is

1429
00:55:21,650 --> 00:55:19,829
I'd say I feel like Here I am and I call

1430
00:55:22,910 --> 00:55:21,660
myself mid-career and I don't know

1431
00:55:24,650 --> 00:55:22,920
what's gonna happen in the next 20 years

1432
00:55:27,140 --> 00:55:24,660
but I know I'm really excited about what

1433
00:55:29,539 --> 00:55:27,150
I'm doing right now and I look back 20

1434
00:55:30,650 --> 00:55:29,549
years earlier and I would never have

1435
00:55:34,010 --> 00:55:30,660
guessed that I'd be doing what I'm doing

1436
00:55:35,359 --> 00:55:34,020
today but I was really committed to what

1437
00:55:37,430 --> 00:55:35,369
I was working on at the time

1438
00:55:40,520 --> 00:55:37,440

so just committing yourself and really

1439
00:55:43,640 --> 00:55:40,530
digging into that moment is my biggest

1440
00:55:44,930 --> 00:55:43,650
piece of advice thank you alex is so

1441
00:55:46,579 --> 00:55:44,940
much and thank you so much for taking

1442
00:55:48,470 --> 00:55:46,589
the time to come with us today and we

1443
00:55:49,730 --> 00:55:48,480
know you're a very busy scientist and

1444
00:55:51,799 --> 00:55:49,740
teacher and mentor and all the other

1445
00:55:53,120 --> 00:55:51,809
great things you do and so the time you

1446
00:55:54,710 --> 00:55:53,130
took to speak with us today was

1447
00:55:56,539 --> 00:55:54,720
absolutely fantastic I learned a lot and

1448
00:55:58,130 --> 00:55:56,549
received a lot of a wisdom from you

1449
00:55:59,930 --> 00:55:58,140
thank you those of you who are watching

1450
00:56:01,279 --> 00:55:59,940
thank you for connecting with us it was

1451
00:56:04,279 --> 00:56:01,289
awesome and the questions that came were

1452
00:56:06,559 --> 00:56:04,289
fantastic so join us next month for ask

1453
00:56:08,780 --> 00:56:06,569
an astrobiologist and please until then