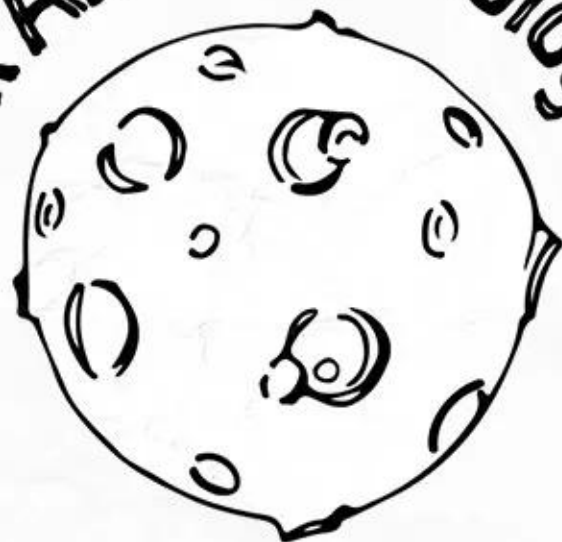


Ask An Astrobiologist



EPISODE 13: JULY 24TH, 2018

DR. JENNIFER GLASS



ASTROBIOLOGY PROGRAM

1
00:00:00,500 --> 00:00:29,769

[Music]

2
00:00:34,160 --> 00:00:31,700
greetings friends of astrobiology

3
00:00:35,780 --> 00:00:34,170
welcome to a brand new episode of ask an

4
00:00:37,490 --> 00:00:35,790
astrobiologists a show where we

5
00:00:39,530 --> 00:00:37,500
celebrate science and celebrate

6
00:00:40,670 --> 00:00:39,540
scientists my name is Sanjay zoom and

7
00:00:42,440 --> 00:00:40,680
this program is made possible by

8
00:00:44,840 --> 00:00:42,450
contributions from the NASA Astrobiology

9
00:00:47,150 --> 00:00:44,850
program and the non profit blue mobile

10
00:00:49,369 --> 00:00:47,160
space today we were extremely lucky to

11
00:00:51,650 --> 00:00:49,379
welcome dr. Jennifer glass was a

12
00:00:53,240 --> 00:00:51,660
professor of biogeochemistry at the

13
00:00:55,459 --> 00:00:53,250

Georgia Institute of Technology as our

14

00:00:58,069 --> 00:00:55,469

guest but first it's your favorite

15

00:01:00,080 --> 00:00:58,079

monthly background quiz last month we

16

00:01:02,920 --> 00:01:00,090

had a picture of a beautiful sight Mike

17

00:01:06,140 --> 00:01:02,930

if you can put it up for a few seconds

18

00:01:09,170 --> 00:01:06,150

it was of course the beautiful Mono Lake

19

00:01:11,390 --> 00:01:09,180

which is east of Yosemite National Park

20

00:01:14,719 --> 00:01:11,400

in California in the United States and

21

00:01:17,240 --> 00:01:14,729

the person who got it right is Marian

22

00:01:19,820 --> 00:01:17,250

Denton Marian congratulations you'll be

23

00:01:21,950 --> 00:01:19,830

winning the full set of the ask an

24

00:01:24,530 --> 00:01:21,960

astrobiologist or other the astrobiology

25

00:01:27,440 --> 00:01:24,540

graphic novels as well as some and NASA

26

00:01:29,810 --> 00:01:27,450

stickers congratulations next month's

27

00:01:31,580 --> 00:01:29,820

your job is to guess what is behind me

28

00:01:32,480 --> 00:01:31,590

it's a little bit harder this time but

29

00:01:35,300 --> 00:01:32,490

enjoy it

30

00:01:37,580 --> 00:01:35,310

Mono Lake is a fantastic Lake Inn in

31

00:01:40,399 --> 00:01:37,590

California it's a very alkaline and had

32

00:01:42,590 --> 00:01:40,409

is these beautiful towers of calcium

33

00:01:43,969 --> 00:01:42,600

carbonate called tufas and they are

34

00:01:45,530 --> 00:01:43,979

formed and they testified to the

35

00:01:48,440 --> 00:01:45,540

presence of underwater springs to

36

00:01:50,510 --> 00:01:48,450

deliver calcium which react react

37

00:01:52,880 --> 00:01:50,520

chemically was the carbonate that's in

38

00:01:55,760 --> 00:01:52,890

the water to form those towers and so

39

00:01:57,289 --> 00:01:55,770

when the lake levels fell those reveals

40

00:01:59,179 --> 00:01:57,299

those beautiful towers so if you get a

41

00:02:00,859 --> 00:01:59,189

chance to head down to Mono Lake highly

42

00:02:02,780 --> 00:02:00,869

recommend it it is really a feast for

43

00:02:05,240 --> 00:02:02,790

the eyes have also some other exciting

44

00:02:08,059 --> 00:02:05,250

news together with ask an astrobiologist

45

00:02:11,150 --> 00:02:08,069

and Signet we welcome dr. Graham Lau who

46

00:02:12,410 --> 00:02:11,160

is in the chat room right now dr. Lau is

47

00:02:13,790 --> 00:02:12,420

an astrobiologist and a research

48

00:02:15,260 --> 00:02:13,800

scientist at the

49

00:02:17,930 --> 00:02:15,270

space institute of science and he will

50

00:02:19,610 --> 00:02:17,940

be co-hosting askin astrobiologists with

51
00:02:21,680 --> 00:02:19,620
me so we'll be alternating more or less

52
00:02:23,600 --> 00:02:21,690
who presents the show and it's going to

53
00:02:26,540 --> 00:02:23,610
be a wonderful experience to welcome him

54
00:02:29,300 --> 00:02:26,550
on board but enough enough about us this

55
00:02:31,730 --> 00:02:29,310
program is meant to focus on a fantastic

56
00:02:33,620 --> 00:02:31,740
scientist of astrobiology and with that

57
00:02:37,420 --> 00:02:33,630
we have a dr. Jennifer glass with us

58
00:02:45,490 --> 00:02:37,430
today Jennifer how are you today great

59
00:02:47,330 --> 00:02:45,500
wonderful you're a professor of

60
00:02:49,220 --> 00:02:47,340
biogeochemistry at the Georgia Institute

61
00:02:52,030 --> 00:02:49,230
of Technology in the city of Atlanta in

62
00:02:55,550 --> 00:02:52,040
America and could you tell us what is

63
00:02:59,990 --> 00:02:55,560

biogeochemistry to begin with yes well

64

00:03:03,080 --> 00:03:00,000

as you know we like to in astrobiology

65

00:03:05,740 --> 00:03:03,090

sometimes it's kind of like in a German

66

00:03:09,230 --> 00:03:05,750

these string these words together and so

67

00:03:12,770 --> 00:03:09,240

obviously it's biogeochemistry right is

68

00:03:17,470 --> 00:03:12,780

the kind of intermingling of biology and

69

00:03:20,540 --> 00:03:17,480

geology and chemistry and also physics

70

00:03:22,850 --> 00:03:20,550

is needed in there as well so it's

71

00:03:26,840 --> 00:03:22,860

essentially kind of at all Sciences

72

00:03:29,330 --> 00:03:26,850

merged together and like astrobiology is

73

00:03:31,940 --> 00:03:29,340

as well so sometimes I call myself an

74

00:03:35,900 --> 00:03:31,950

astrobiologist sometimes biogeochemistry

75

00:03:38,150 --> 00:03:35,910

on microbiologist it's hard to kind of

76
00:03:40,400 --> 00:03:38,160
come up with a single name because it's

77
00:03:42,980 --> 00:03:40,410
such an interdisciplinary field but

78
00:03:45,770 --> 00:03:42,990
basically what biogeochemistry

79
00:03:49,580 --> 00:03:45,780
interested in is thinking about how

80
00:03:53,660 --> 00:03:49,590
chemical elements how the elements on

81
00:03:56,690 --> 00:03:53,670
the periodic table cycle through earth

82
00:03:58,220 --> 00:03:56,700
systems and also especially in

83
00:04:02,240 --> 00:03:58,230
astrobiology we like to think about

84
00:04:06,290 --> 00:04:02,250
other planetary systems as well and that

85
00:04:08,330 --> 00:04:06,300
often comes down to microbial reactions

86
00:04:10,220 --> 00:04:08,340
because the microbes are actually who

87
00:04:12,350 --> 00:04:10,230
can really catalyze a lot of this

88
00:04:15,170 --> 00:04:12,360

chemistry much faster than the abiotic

89

00:04:19,010 --> 00:04:15,180

processes and so that's the connection

90

00:04:21,170 --> 00:04:19,020

into microbiology as well so you look at

91

00:04:22,580 --> 00:04:21,180

microbes you look at gases you think

92

00:04:23,150 --> 00:04:22,590

about the atmosphere you think about

93

00:04:24,980 --> 00:04:23,160

rocks

94

00:04:26,810 --> 00:04:24,990

you're a true astrobiologists right you

95

00:04:27,590 --> 00:04:26,820

can't do modern astrobiology by being

96

00:04:29,420 --> 00:04:27,600

focused on a

97

00:04:35,360 --> 00:04:29,430

particular discipline even most science

98

00:04:37,520 --> 00:04:35,370

today one could say that indeed so

99

00:04:39,560 --> 00:04:37,530

presumably you weren't a six-year-old

100

00:04:41,840 --> 00:04:39,570

looking at Iraq and thinking I want to

101
00:04:43,670 --> 00:04:41,850
become a bio geochemist but could you

102
00:04:45,680 --> 00:04:43,680
tell us the story perhaps an irrigated

103
00:04:47,600 --> 00:04:45,690
what triggered this interest in science

104
00:04:49,910 --> 00:04:47,610
and discuss your career path and how to

105
00:04:53,030 --> 00:04:49,920
become a bio geochemist interested in

106
00:04:57,490 --> 00:04:53,040
astrobiology I was really fortunate to

107
00:05:00,770 --> 00:04:57,500
grow up in the beautiful states where

108
00:05:03,140 --> 00:05:00,780
darksome and I also happen to have gone

109
00:05:05,330 --> 00:05:03,150
to school at the same time he as a

110
00:05:06,440 --> 00:05:05,340
graduate student and myself as an

111
00:05:09,800 --> 00:05:06,450
undergraduate at University of

112
00:05:13,160 --> 00:05:09,810
Washington and I grew up in Olympia

113
00:05:14,780 --> 00:05:13,170

Washington and which is for those of you

114

00:05:16,460 --> 00:05:14,790

who haven't visited the Pacific

115

00:05:19,790 --> 00:05:16,470

Northwest of the United States before

116

00:05:23,720 --> 00:05:19,800

it's a beautiful place it's there's

117

00:05:26,450 --> 00:05:23,730

volcanoes there's rain tempering forests

118

00:05:30,590 --> 00:05:26,460

on the Olympic Peninsula it's kind of a

119

00:05:34,820 --> 00:05:30,600

marvelous wonderland of biogeochemistry

120

00:05:36,740 --> 00:05:34,830

and biodiversity and I think that I was

121

00:05:39,650 --> 00:05:36,750

I was very fortunate to grow up in a

122

00:05:43,670 --> 00:05:39,660

place that I think naturally just gets

123

00:05:48,290 --> 00:05:43,680

you thinking about Earth processes and I

124

00:05:52,520 --> 00:05:48,300

actually did my first year of college at

125

00:05:53,990 --> 00:05:52,530

UC Santa Cruz and I know maybe we'll

126

00:05:55,700 --> 00:05:54,000

talk later about mentors and how

127

00:05:57,550 --> 00:05:55,710

important they are because there were

128

00:06:00,080 --> 00:05:57,560

some mentors there that really

129

00:06:03,800 --> 00:06:00,090

encouraged me and drew me into actually

130

00:06:05,300 --> 00:06:03,810

oceanography and then I basically alter

131

00:06:08,150 --> 00:06:05,310

undergrad it was really hard for me to

132

00:06:12,410 --> 00:06:08,160

decide what to major in because I was

133

00:06:14,030 --> 00:06:12,420

interested in everything but I'm you

134

00:06:16,880 --> 00:06:14,040

know I've interested in all Natural

135

00:06:20,240 --> 00:06:16,890

Sciences basically and biology and

136

00:06:24,260 --> 00:06:20,250

chemistry but I really like the applied

137

00:06:27,290 --> 00:06:24,270

side of it um and so that's how I came

138

00:06:29,780 --> 00:06:27,300

to geosciences and I've always been in

139

00:06:33,050 --> 00:06:29,790

geosciences ever since and the beauty of

140

00:06:36,469 --> 00:06:33,060

geosciences is that they let us it's

141

00:06:40,550 --> 00:06:36,479

it's pretty interdisciplinary as well as

142

00:06:40,999 --> 00:06:40,560

increasingly really all of science is we

143

00:06:42,999 --> 00:06:41,009

have to be

144

00:06:45,320 --> 00:06:43,009

more interdisciplinary because of the

145

00:06:48,859 --> 00:06:45,330

intersections is really where the

146

00:06:50,450 --> 00:06:48,869

interesting problems and answers are so

147

00:06:52,929 --> 00:06:50,460

I've been fortunate to be able to do

148

00:06:56,629 --> 00:06:52,939

this very interdisciplinary science in

149

00:06:57,950 --> 00:06:56,639

Geoscience departments ever ever since I

150

00:07:00,079 --> 00:06:57,960

was in college

151

00:07:02,149 --> 00:07:00,089

wonderful so you go to your

152

00:07:04,730 --> 00:07:02,159

undergraduate degree in geology and then

153

00:07:07,429 --> 00:07:04,740

you moved to Arizona State University

154

00:07:10,790 --> 00:07:07,439

for your doctorate how was that

155

00:07:12,859 --> 00:07:10,800

transition yeah well I was fortunate to

156

00:07:14,869 --> 00:07:12,869

have wonderful mentors at University of

157

00:07:19,100 --> 00:07:14,879

Washington and some of some of whom we

158

00:07:21,260 --> 00:07:19,110

share talked about and there was a

159

00:07:23,689 --> 00:07:21,270

wonderful astrobiology program as well

160

00:07:26,269 --> 00:07:23,699

and so that was I really got interested

161

00:07:29,149 --> 00:07:26,279

originally in astrobiology and that was

162

00:07:30,950 --> 00:07:29,159

how I found out about Arizona State and

163

00:07:34,219 --> 00:07:30,960

some of the really exciting research

164

00:07:36,049 --> 00:07:34,229

going on there so it was well the

165

00:07:38,779 --> 00:07:36,059

transition to graduate school is a

166

00:07:41,179 --> 00:07:38,789

really is a challenging one I think for

167

00:07:45,980 --> 00:07:41,189

a lot of people and it was challenging

168

00:07:48,110 --> 00:07:45,990

for me as well especially going from it

169

00:07:50,959 --> 00:07:48,120

like you said the geosciences and then

170

00:07:55,189 --> 00:07:50,969

trying to learn basically this whole new

171

00:07:58,939 --> 00:07:55,199

world of microbiology and also a fair

172

00:08:01,399 --> 00:07:58,949

bit of biochemistry as well and it took

173

00:08:04,579 --> 00:08:01,409

its take I'm still in the process of

174

00:08:06,199 --> 00:08:04,589

doing that you never stop learning

175

00:08:08,629 --> 00:08:06,209

that's the beauty of the site to take

176

00:08:10,759 --> 00:08:08,639

disciplinary yeah that's a good thing

177

00:08:13,969 --> 00:08:10,769

exactly I'll never be done

178

00:08:15,499 --> 00:08:13,979

transy you know transitioning around

179

00:08:18,049 --> 00:08:15,509

between those and I've just been

180

00:08:19,639 --> 00:08:18,059

fortunate to be able to do that in this

181

00:08:22,009 --> 00:08:19,649

community and to be able to work on

182

00:08:22,790 --> 00:08:22,019

quite a number of different different

183

00:08:25,519 --> 00:08:22,800

problems

184

00:08:28,100 --> 00:08:25,529

that's just naturally how what I like to

185

00:08:29,570 --> 00:08:28,110

do I get excited about a lot of

186

00:08:31,279 --> 00:08:29,580

different things I try to focus on

187

00:08:34,909 --> 00:08:31,289

something long enough to finish it

188

00:08:36,889 --> 00:08:34,919

please get some papers out but we can

189

00:08:38,839 --> 00:08:36,899

talk more about that about what I'm

190

00:08:41,209 --> 00:08:38,849

excited about late lately yeah yeah

191

00:08:42,709 --> 00:08:41,219

absolutely azzam is like oozing out of

192

00:08:44,240 --> 00:08:42,719

the screen that I have in front of me

193

00:08:46,519 --> 00:08:44,250

it's wonderful but let's talk about

194

00:08:47,900 --> 00:08:46,529

mentors a little bit let's talk about

195

00:08:50,480 --> 00:08:47,910

mentors a little bit because the

196

00:08:52,400 --> 00:08:50,490

scientific path through school is not

197

00:08:54,480 --> 00:08:52,410

the easiest path one can choose to get a

198

00:08:56,820 --> 00:08:54,490

degree in and get multiple degrees and

199

00:08:58,380 --> 00:08:56,830

and people might think that they're not

200

00:08:59,820 --> 00:08:58,390

smart enough not good enough to do this

201

00:09:01,530 --> 00:08:59,830

carrier but of course it's it's

202

00:09:04,019 --> 00:09:01,540

incorrect all of us who have gone

203

00:09:06,180 --> 00:09:04,029

through the the school in the sciences

204

00:09:07,949 --> 00:09:06,190

have benefited from mentors and I

205

00:09:10,139 --> 00:09:07,959

wondering if you could share some some

206

00:09:11,630 --> 00:09:10,149

stories about the the people and perhaps

207

00:09:14,240 --> 00:09:11,640

even give them a little shout out who

208

00:09:16,320 --> 00:09:14,250

encouraged you over the years yes

209

00:09:18,180 --> 00:09:16,330

absolutely and there's more than I can

210

00:09:20,579 --> 00:09:18,190

possibly talk about here but I want to

211

00:09:23,310 --> 00:09:20,589

go all the way back to K through 12

212

00:09:25,230 --> 00:09:23,320

because it's really I think especially

213

00:09:28,110 --> 00:09:25,240

in the states which is what I can speak

214

00:09:32,490 --> 00:09:28,120

to and in the public school systems in

215

00:09:35,150 --> 00:09:32,500

the states you know our teachers work so

216

00:09:38,970 --> 00:09:35,160

amazingly hard for very little money and

217

00:09:40,920 --> 00:09:38,980

I was so so blessed to have such amazing

218

00:09:43,019 --> 00:09:40,930

science teachers in school because it

219

00:09:44,550 --> 00:09:43,029

was really my middle school science

220

00:09:48,389 --> 00:09:44,560

teachers who were both women actually

221

00:09:51,660 --> 00:09:48,399

and especially my really both of them my

222

00:09:53,910 --> 00:09:51,670

7th grade science teacher Carol Sardar

223

00:09:56,910 --> 00:09:53,920

and then my 8th grade science teacher

224

00:09:59,460 --> 00:09:56,920

Mattie Martin they both really directed

225

00:10:03,930 --> 00:09:59,470

me Carol very much on the Natural

226

00:10:07,319 --> 00:10:03,940

Sciences side and then miss Martin I'll

227

00:10:08,610 --> 00:10:07,329

call her more on the track for going

228

00:10:10,610 --> 00:10:08,620

forward

229

00:10:15,870 --> 00:10:10,620

I don't think I would be where I am

230

00:10:18,360 --> 00:10:15,880

without those two amazing women and then

231

00:10:21,510 --> 00:10:18,370

after that I'll just name four amazing

232

00:10:24,810 --> 00:10:21,520

women and then I'll I can give many

233

00:10:27,210 --> 00:10:24,820

probably hundreds more but then my first

234

00:10:30,840 --> 00:10:27,220

year of college actually I was like I

235

00:10:34,889 --> 00:10:30,850

said I I wasn't sure what I wanted to do

236

00:10:37,530 --> 00:10:34,899

I was very much interested in saving the

237

00:10:39,510 --> 00:10:37,540

planet that's what I wanted to do I

238

00:10:43,230 --> 00:10:39,520

wanted to save the planet just you know

239

00:10:44,100 --> 00:10:43,240

whooping so what do you see Santa Cruz

240

00:10:46,579 --> 00:10:44,110

because they have a really good

241

00:10:50,880 --> 00:10:46,589

environmental science program and

242

00:10:54,510 --> 00:10:50,890

amazingly the summer before I started at

243

00:10:57,800 --> 00:10:54,520

UC Santa Cruz I got an email out of the

244

00:11:00,600 --> 00:10:57,810

blue from a faculty member who is

245

00:11:04,320 --> 00:11:00,610

professor on a Christina Ravello at UC

246

00:11:06,180 --> 00:11:04,330

Santa Cruz saying you know I saw your

247

00:11:07,740 --> 00:11:06,190

undergraduate application and I was

248

00:11:11,610 --> 00:11:07,750

really impressed and would you like to

249

00:11:14,579 --> 00:11:11,620

come work in my lab and that was I mean

250

00:11:16,290 --> 00:11:14,589

you can imagine how honored so you know

251
00:11:18,600 --> 00:11:16,300
the year I spent there I ended up

252
00:11:21,329 --> 00:11:18,610
transferring to University of Washington

253
00:11:24,810 --> 00:11:21,339
after that but the year I spent in her

254
00:11:27,990 --> 00:11:24,820
lab at UC Santa Cruz that absolutely

255
00:11:30,090 --> 00:11:28,000
made me with huge in terms of getting me

256
00:11:32,300 --> 00:11:30,100
interested in oceanography she works on

257
00:11:38,010 --> 00:11:32,310
her group works on Haley oceanography

258
00:11:40,230 --> 00:11:38,020
and you know just being in a lab group

259
00:11:42,240 --> 00:11:40,240
for the first time as a freshman in

260
00:11:46,590 --> 00:11:42,250
college and just kind of seeing the

261
00:11:49,920 --> 00:11:46,600
inside track there and I remember I was

262
00:11:51,780 --> 00:11:49,930
working with her graduate student who's

263
00:11:54,570 --> 00:11:51,790

now at Stanford

264

00:11:59,579 --> 00:11:54,580

there was also you know I was supposed

265

00:12:02,280 --> 00:11:59,589

to be talking about mentors and then

266

00:12:03,840 --> 00:12:02,290

I'll just move on from there and jump

267

00:12:05,670 --> 00:12:03,850

forward a little bit because I want to

268

00:12:08,819 --> 00:12:05,680

give a big shout-out to police a wolf

269

00:12:11,760 --> 00:12:08,829

Simon who actually was my mentor my

270

00:12:16,730 --> 00:12:11,770

first year at RAL on bars lab at Arizona

271

00:12:21,030 --> 00:12:16,740

State University and Felisa was

272

00:12:23,220 --> 00:12:21,040

absolutely the best mentor I think I can

273

00:12:27,300 --> 00:12:23,230

say I've ever had I hope she's watching

274

00:12:31,800 --> 00:12:27,310

this but I want to say thank you Felisa

275

00:12:34,860 --> 00:12:31,810

because I'm gonna choke because we had

276

00:12:37,829 --> 00:12:34,870

um you know she was just amazing to me

277

00:12:40,170 --> 00:12:37,839

and she really taught me what I know

278

00:12:42,240 --> 00:12:40,180

about you know definitely growing

279

00:12:45,060 --> 00:12:42,250

cyanobacteria that's for sure we grow a

280

00:12:46,769 --> 00:12:45,070

lot of cyanobacteria in that lab in the

281

00:12:49,980 --> 00:12:46,779

basement and of Phoenix

282

00:12:53,670 --> 00:12:49,990

getting liquid nitrogen in the 120

283

00:12:56,389 --> 00:12:53,680

degrees took a while so I wanna yeah

284

00:12:58,470 --> 00:12:56,399

save a huge thank you to police'

285

00:13:00,060 --> 00:12:58,480

this illustrates that the scientific

286

00:13:02,340 --> 00:13:00,070

career is an emotional world as well

287

00:13:05,880 --> 00:13:02,350

which is important to grow in that in

288

00:13:08,250 --> 00:13:05,890

that that facets so after your PhD at

289

00:13:10,139 --> 00:13:08,260

Arizona State you did a postdoc at the

290

00:13:11,850 --> 00:13:10,149

California Institute of Technology and

291

00:13:14,640 --> 00:13:11,860

now you have your own lab at Georgia

292

00:13:17,250 --> 00:13:14,650

Institute of Technology and the I guess

293

00:13:17,940 --> 00:13:17,260

the title of your lab is Mars methane

294

00:13:29,870 --> 00:13:17,950

and

295

00:13:33,300 --> 00:13:29,880

M's tell us about what your lab does its

296

00:13:36,120 --> 00:13:33,310

methane microbes and metals like they

297

00:13:38,100 --> 00:13:36,130

microbes we switch in and out so you're

298

00:13:40,220 --> 00:13:38,110

right maybe I couldn't I don't know if I

299

00:13:42,900 --> 00:13:40,230

can call myself enough of a Mars person

300

00:13:45,150 --> 00:13:42,910

Portland's trying to beef up on my Mars

301
00:13:48,569 --> 00:13:45,160
but you're right yes metals methane and

302
00:13:51,210 --> 00:13:48,579
microbes like and we do more than that

303
00:13:52,710 --> 00:13:51,220
now but that was a fun alliteration that

304
00:13:55,230 --> 00:13:52,720
I came up with actually you know I think

305
00:14:01,639 --> 00:13:55,240
I have that idea at at Brad Cohn in

306
00:14:08,420 --> 00:14:04,970
what was your question what does your

307
00:14:11,850 --> 00:14:08,430
alliterative lab do what do we do okay

308
00:14:15,780 --> 00:14:11,860
right and so we're interested in

309
00:14:21,210 --> 00:14:15,790
thinking about the cycling through space

310
00:14:24,240 --> 00:14:21,220
and time to mostly to greenhouse gases

311
00:14:26,519 --> 00:14:24,250
we co2 a lot of people work on so we

312
00:14:29,610 --> 00:14:26,529
work on the kind of a little bit more

313
00:14:33,199 --> 00:14:29,620

neglected ones that are methane and

314

00:14:37,590 --> 00:14:33,209

nitrous oxide the second and third most

315

00:14:40,079 --> 00:14:37,600

important greenhouse gases after co2 and

316

00:14:42,900 --> 00:14:40,089

so we're really interested in how

317

00:14:45,689 --> 00:14:42,910

microbes cycle those those greenhouse

318

00:14:48,030 --> 00:14:45,699

gases but also how interactions between

319

00:14:51,980 --> 00:14:48,040

chemistry and the microbes can be really

320

00:14:55,740 --> 00:14:51,990

important for those for those gases so

321

00:14:58,139 --> 00:14:55,750

methane and nitrous oxide laughing gas

322

00:14:59,670 --> 00:14:58,149

as it's known we're really important to

323

00:15:01,410 --> 00:14:59,680

warm the ancient earth

324

00:15:03,540 --> 00:15:01,420

you know several billion years ago at

325

00:15:05,069 --> 00:15:03,550

that time as we know the Sun was fainter

326

00:15:07,230 --> 00:15:05,079

so we needed those greenhouse gases to

327

00:15:09,059 --> 00:15:07,240

keep the planet warm and so right now

328

00:15:11,189 --> 00:15:09,069

those gases are not so present in our

329

00:15:12,840 --> 00:15:11,199

atmosphere so the wonderful discipline

330

00:15:14,280 --> 00:15:12,850

of atmospheric evolution is probably

331

00:15:16,650 --> 00:15:14,290

what you're interested in as well and

332

00:15:18,389 --> 00:15:16,660

practically that transition around 2.4

333

00:15:20,670 --> 00:15:18,399

billion years ago when the earth

334

00:15:22,559 --> 00:15:20,680

transitioned to have a oxygen in the

335

00:15:25,100 --> 00:15:22,569

atmosphere and that changed quite a bit

336

00:15:27,990 --> 00:15:25,110

decomposition of the air as well as the

337

00:15:29,550 --> 00:15:28,000

effects on microbes so when we think

338

00:15:31,170 --> 00:15:29,560

about the evolution of the air we have

339

00:15:33,740 --> 00:15:31,180

to think about your fusion of the land

340

00:15:38,450 --> 00:15:33,750

when micros comes contributed hence the

341

00:15:42,780 --> 00:15:38,460

biogeochemistry I think exactly exactly

342

00:15:44,460 --> 00:15:42,790

yeah and your oh go ahead sooner talk

343

00:15:46,920 --> 00:15:44,470

about one of your papers that's coming

344

00:15:48,690 --> 00:15:46,930

out in in very soon in geobiology

345

00:15:51,570 --> 00:15:48,700

talking about a new interpretation or

346

00:15:53,430 --> 00:15:51,580

new explanation for it is for this

347

00:15:56,460 --> 00:15:53,440

laughing gas in the atmosphere earth

348

00:15:59,340 --> 00:15:56,470

several billion years ago yes and the

349

00:16:01,620 --> 00:15:59,350

first author is Chloe Stanton who spent

350

00:16:04,830 --> 00:16:01,630

four years in my lab as an undergraduate

351
00:16:07,470 --> 00:16:04,840
here in Earth and Atmospheric Sciences

352
00:16:10,260 --> 00:16:07,480
at Georgia Tech and then now it's gone

353
00:16:12,690 --> 00:16:10,270
on to work at Penn State in their

354
00:16:15,210 --> 00:16:12,700
astrobiology group so I'm really really

355
00:16:19,160 --> 00:16:15,220
proud of her

356
00:16:22,740 --> 00:16:19,170
and this is also this study is funded by

357
00:16:26,850 --> 00:16:22,750
NASA Astrobiology and specifically the

358
00:16:28,770 --> 00:16:26,860
alternative Earth's team that's based

359
00:16:31,640 --> 00:16:28,780
out of UC Riverside and we also have a

360
00:16:34,230 --> 00:16:31,650
node here at Georgia Tech so basically

361
00:16:36,810 --> 00:16:34,240
we were interested and this kind of

362
00:16:39,540 --> 00:16:36,820
dates back my interest in nitrogen

363
00:16:42,150 --> 00:16:39,550

actually dates back to essentially when

364

00:16:46,440 --> 00:16:42,160

I first met Sanjoy which which was I

365

00:16:50,160 --> 00:16:46,450

think what 2004 is sure so thereabouts

366

00:16:54,740 --> 00:16:50,170

uh-huh maybe fifteen years ago I don't

367

00:16:59,040 --> 00:16:54,750

know what something like that yeah yeah

368

00:17:01,950 --> 00:16:59,050

and so at University of Washington

369

00:17:05,100 --> 00:17:01,960

actually and we had a shared mentor

370

00:17:08,640 --> 00:17:05,110

Roger Buick who maybe yeah many of you

371

00:17:11,250 --> 00:17:08,650

know and a wonderful mentor and so this

372

00:17:14,820 --> 00:17:11,260

is originally actually I think it this

373

00:17:17,430 --> 00:17:14,830

hypothesis as far as I can tell of this

374

00:17:22,199 --> 00:17:17,440

laughing gas atmosphere is was really

375

00:17:25,920 --> 00:17:22,209

originated with Roger Buick and he came

376

00:17:28,440 --> 00:17:25,930

up with this idea that maybe laughing

377

00:17:31,650 --> 00:17:28,450

gas which is a quite a potent greenhouse

378

00:17:34,230 --> 00:17:31,660

gas was more abundant in this middle

379

00:17:37,710 --> 00:17:34,240

period of Earth history and so we're

380

00:17:40,710 --> 00:17:37,720

really really focused on that same topic

381

00:17:42,510 --> 00:17:40,720

and in terms of which is what a lot of

382

00:17:43,970 --> 00:17:42,520

my lab is is kind of focused on is

383

00:17:47,539 --> 00:17:43,980

thinking how

384

00:17:50,600 --> 00:17:47,549

a really metal rich ocean specifically

385

00:17:52,909 --> 00:17:50,610

iron but also manganese

386

00:17:55,039 --> 00:17:52,919

we know that the ocean it could have had

387

00:17:56,450 --> 00:17:55,049

up to millimolar levels maybe a little

388

00:17:59,630 --> 00:17:56,460

lower there's a lot of debate about that

389

00:18:02,570 --> 00:17:59,640

but there was it was loaded with ferrous

390

00:18:04,460 --> 00:18:02,580

iron soluble ferrous iron and there was

391

00:18:08,060 --> 00:18:04,470

a lot of rapid cycling through the

392

00:18:10,700 --> 00:18:08,070

ferris wheel of redox cycling so how

393

00:18:13,549 --> 00:18:10,710

would that iron rich ocean have affected

394

00:18:15,710 --> 00:18:13,559

the nitrogen cycle and actually it's

395

00:18:19,630 --> 00:18:15,720

long been known in the soil literature

396

00:18:23,900 --> 00:18:19,640

that if you react oxidized nitrogen

397

00:18:26,390 --> 00:18:23,910

species like nitrite and nitric oxide if

398

00:18:28,700 --> 00:18:26,400

there's a lot of iron around they react

399

00:18:30,590 --> 00:18:28,710

and they make nitrous oxide actually

400

00:18:34,580 --> 00:18:30,600

chemically this doesn't and it's very

401
00:18:37,130 --> 00:18:34,590
quick and it it so that's been long

402
00:18:39,860 --> 00:18:37,140
known and we we basically did

403
00:18:42,590 --> 00:18:39,870
experiments in the lab to show that you

404
00:18:45,860 --> 00:18:42,600
can very rapidly get a lot of conversion

405
00:18:48,320 --> 00:18:45,870
to nitrous oxide just from that iron

406
00:18:51,490 --> 00:18:48,330
chemistry essentially and so that's kind

407
00:18:54,820 --> 00:18:51,500
of our new proposed mechanism for a

408
00:18:57,830 --> 00:18:54,830
potential laughing gas Buick atmosphere

409
00:19:00,260 --> 00:18:57,840
with implications as well that I can

410
00:19:04,039 --> 00:19:00,270
talk about if you're interested for the

411
00:19:07,490 --> 00:19:04,049
evolution of aerobic respiration what

412
00:19:09,799 --> 00:19:07,500
we're doing right now fascinating yeah I

413
00:19:11,810 --> 00:19:09,809

mean this is this whole amount or

414

00:19:13,520 --> 00:19:11,820

abundance of metals in the ocean is

415

00:19:16,100 --> 00:19:13,530

important because prior to the earth

416

00:19:17,990 --> 00:19:16,110

having oxygen atmosphere the ocean also

417

00:19:19,850 --> 00:19:18,000

didn't have any oxygen inside it and so

418

00:19:22,190 --> 00:19:19,860

the iron could accumulate and as oxygen

419

00:19:24,950 --> 00:19:22,200

started to rise all the iron can oxidize

420

00:19:26,690 --> 00:19:24,960

which for metals and fell down and also

421

00:19:28,490 --> 00:19:26,700

the oxygen in the atmosphere kind of

422

00:19:30,470 --> 00:19:28,500

prevented large amounts of metal

423

00:19:32,720 --> 00:19:30,480

flushing down into the oceans was

424

00:19:34,130 --> 00:19:32,730

changed the amount of copper and I know

425

00:19:38,570 --> 00:19:34,140

nickel that you're interested in as well

426

00:19:40,460 --> 00:19:38,580

and bacteria use these metals in the

427

00:19:43,340 --> 00:19:40,470

enzymes in their proteins they used to

428

00:19:45,230 --> 00:19:43,350

change the chemistry of nitrogen all the

429

00:19:47,630 --> 00:19:45,240

way back to N_2 which is what we breathe

430

00:19:49,880 --> 00:19:47,640

and copper was very important in that

431

00:19:52,490 --> 00:19:49,890

last step as you were mentioning and was

432

00:19:54,530 --> 00:19:52,500

a lack of coppered perhaps it's a

433

00:19:57,320 --> 00:19:54,540

hypothesis bacteria could not go from

434

00:19:57,680 --> 00:19:57,330

that last step nitrous oxide to N_2 and

435

00:19:59,389 --> 00:19:57,690

so the

436

00:20:01,639 --> 00:19:59,399

mr. stay that nitrous-oxide resist

437

00:20:03,350 --> 00:20:01,649

fascinate so you you bring in the

438

00:20:05,749 --> 00:20:03,360

importance of ayran in that story which

439

00:20:08,930 --> 00:20:05,759

is cool right yes

440

00:20:10,970 --> 00:20:08,940

and just as an alternative pathway

441

00:20:14,590 --> 00:20:10,980

essentially for how to get the nitrous

442

00:20:17,330 --> 00:20:14,600

oxide now in terms of how they how the

443

00:20:19,669 --> 00:20:17,340

you know how much of that nitrous oxide

444

00:20:22,399 --> 00:20:19,679

the organisms could actually breathe is

445

00:20:25,850 --> 00:20:22,409

another question whether it was copper

446

00:20:27,560 --> 00:20:25,860

limitation that controlled it there's

447

00:20:29,960 --> 00:20:27,570

actually new data kind of showing that

448

00:20:32,210 --> 00:20:29,970

copper has been pretty consistent that's

449

00:20:34,940 --> 00:20:32,220

the latest I heard so that's a little

450

00:20:37,580 --> 00:20:34,950

you know questionable there but if a

451
00:20:39,409 --> 00:20:37,590
regardless it's very important to

452
00:20:41,570 --> 00:20:39,419
understand that last step because that

453
00:20:44,119 --> 00:20:41,580
last step the last two steps of

454
00:20:49,340 --> 00:20:44,129
denitrification merged together and

455
00:20:52,460 --> 00:20:49,350
became how we breathe oxygen so that's

456
00:20:54,850 --> 00:20:52,470
what really has me excited lately is

457
00:21:00,619 --> 00:20:54,860
thinking about the evolution of

458
00:21:03,740 --> 00:21:00,629
cytochrome C oxidase a huge interest

459
00:21:06,889 --> 00:21:03,750
obviously that's super important enzyme

460
00:21:08,659 --> 00:21:06,899
for all us humans well tell us more

461
00:21:12,889 --> 00:21:08,669
about this evolution of this aerobes

462
00:21:16,190 --> 00:21:12,899
yeah yeah and so what is an arrow yeah

463
00:21:18,889 --> 00:21:16,200

what's an intro so an arrow is an

464

00:21:22,129 --> 00:21:18,899

organism like we are arrows so we are

465

00:21:26,600 --> 00:21:22,139

using oxygen we're breathing oxygen

466

00:21:28,730 --> 00:21:26,610

right but there are maybe your next

467

00:21:32,720 --> 00:21:28,740

shoot is gonna be what's in what's an

468

00:21:34,610 --> 00:21:32,730

anaerobic so there's there's actually

469

00:21:36,970 --> 00:21:34,620

what what is less well known of course

470

00:21:40,940 --> 00:21:36,980

we've all kind of maybe heard of

471

00:21:42,879 --> 00:21:40,950

breathing oxygen hopefully but maybe not

472

00:21:45,499 --> 00:21:42,889

everybody knows that a lot of

473

00:21:48,080 --> 00:21:45,509

microorganisms can breathe all kinds of

474

00:21:50,659 --> 00:21:48,090

other stuff sized oxygen so they can

475

00:21:54,200 --> 00:21:50,669

breathe all kinds of accidents and their

476
00:21:56,659 --> 00:21:54,210
oxidant does not have to be oxygen and

477
00:21:59,419 --> 00:21:56,669
so those are called anaerobes when

478
00:22:04,970 --> 00:21:59,429
they're breathing not ox something other

479
00:22:07,159 --> 00:22:04,980
than oxygen that leads us to methane for

480
00:22:10,129 --> 00:22:07,169
example because you have some microbes

481
00:22:11,750 --> 00:22:10,139
that breathe carbon dioxide to reduce

482
00:22:14,780 --> 00:22:11,760
hydrogen to form methane

483
00:22:16,850 --> 00:22:14,790
which is we find in bogs kind of on

484
00:22:18,920 --> 00:22:16,860
earth if you kind of go in a muddy bog

485
00:22:20,600 --> 00:22:18,930
and tap the the mud and see those

486
00:22:22,640 --> 00:22:20,610
bubbles come out as typically methane

487
00:22:25,370 --> 00:22:22,650
and nothing is cool because it's been

488
00:22:26,540 --> 00:22:25,380

discovered in the atmosphere of Mars and

489

00:22:28,550 --> 00:22:26,550

I know that somebody has asked a

490

00:22:31,250 --> 00:22:28,560

question which reminds me to ask all of

491

00:22:33,590 --> 00:22:31,260

you that if you have a question use

492

00:22:34,970 --> 00:22:33,600

hashtag ask Astro bio on Twitter for dr.

493

00:22:38,360 --> 00:22:34,980

glass or write it directly on the same

494

00:22:40,640 --> 00:22:38,370

units and we will answer them and so

495

00:22:42,950 --> 00:22:40,650

methane you work directly we're trying

496

00:22:45,500 --> 00:22:42,960

to understand the methane cycle as well

497

00:22:47,750 --> 00:22:45,510

right yeah that's right

498

00:22:51,470 --> 00:22:47,760

yeah and it's it's really exciting their

499

00:22:54,710 --> 00:22:51,480

recent results back from Mars right to

500

00:22:56,750 --> 00:22:54,720

try to figure out where and Enceladus

501
00:22:59,600 --> 00:22:56,760
you know there's it seems like more and

502
00:23:01,340 --> 00:22:59,610
Pluto right lately there's also Pluto

503
00:23:05,060 --> 00:23:01,350
well these are all different different

504
00:23:08,750 --> 00:23:05,070
for there's also methane dunes on it

505
00:23:10,460 --> 00:23:08,760
blows my mind on Pluto right so yeah

506
00:23:12,320 --> 00:23:10,470
there's a lot of recent exciting methane

507
00:23:17,480 --> 00:23:12,330
discoveries and are in our solar system

508
00:23:20,030 --> 00:23:17,490
and and probably beyond as well so yes

509
00:23:21,680 --> 00:23:20,040
yeah let's talk about Mars because it's

510
00:23:23,990 --> 00:23:21,690
it's closer to home and they said we

511
00:23:25,880 --> 00:23:24,000
have a Rover and a couple in fact on the

512
00:23:28,010 --> 00:23:25,890
surface of Mars in particular curiosity

513
00:23:29,720 --> 00:23:28,020

on Gale Crater as an instrument I was

514

00:23:31,970 --> 00:23:29,730

able to detect parts-per-billion

515

00:23:33,470 --> 00:23:31,980

concentrations of methane on the surface

516

00:23:35,450 --> 00:23:33,480

now we know that there are biological

517

00:23:37,220 --> 00:23:35,460

ways of creating methane and their

518

00:23:38,510 --> 00:23:37,230

geological ways of creating methane

519

00:23:42,650 --> 00:23:38,520

nonetheless the fact that there is

520

00:23:45,590 --> 00:23:42,660

methane there is really exciting and and

521

00:23:48,140 --> 00:23:45,600

Mike I think you showed up the picture

522

00:23:50,090 --> 00:23:48,150

of the cycle there of methane on Mars as

523

00:23:51,320 --> 00:23:50,100

we're getting be able to understand more

524

00:23:52,880 --> 00:23:51,330

and more I'm just wondering what are

525

00:23:57,680 --> 00:23:52,890

your thoughts you think it's it's life

526
00:23:59,660 --> 00:23:57,690
on Mars dead so and I think the latest

527
00:24:03,320 --> 00:23:59,670
discovery right is that there's seasonal

528
00:24:06,590 --> 00:24:03,330
variation as well it's very small

529
00:24:10,130 --> 00:24:06,600
quantities right its orders of magnitude

530
00:24:13,490 --> 00:24:10,140
lower than what we have we have what

531
00:24:16,430 --> 00:24:13,500
almost 2 ppm get that right and then

532
00:24:18,890 --> 00:24:16,440
this is like 10 ppb parts that's parts

533
00:24:20,540 --> 00:24:18,900
per million and parts per billion right

534
00:24:23,000 --> 00:24:20,550
so three orders of magnitude different

535
00:24:25,790 --> 00:24:23,010
but still the fact that there's seasonal

536
00:24:29,000 --> 00:24:25,800
variation really has struck people

537
00:24:32,200 --> 00:24:29,010
and okay you know that you know on earth

538
00:24:34,340 --> 00:24:32,210

right seasonal variation with co2 that's

539

00:24:38,410 --> 00:24:34,350

biology that's the earth breathing

540

00:24:41,060 --> 00:24:38,420

literally that's respiration and

541

00:24:43,790 --> 00:24:41,070

photosynthesis right that controls those

542

00:24:45,290 --> 00:24:43,800

seasonal variations and so I think those

543

00:24:49,940 --> 00:24:45,300

seasonal variations let a lot of people

544

00:24:51,890 --> 00:24:49,950

to think yeah could this be biologic

545

00:24:56,480 --> 00:24:51,900

though think about methane is something

546

00:24:59,870 --> 00:24:56,490

like 90% of the methane cycle on earth

547

00:25:02,660 --> 00:24:59,880

in today is biology so it's really

548

00:25:05,480 --> 00:25:02,670

amazing how biology and specifics not

549

00:25:09,320 --> 00:25:05,490

just by all a biology it's a specific

550

00:25:11,720 --> 00:25:09,330

clade of archaea not bacteria they're

551

00:25:16,280 --> 00:25:11,730

archaea the third domain of life who

552

00:25:17,600 --> 00:25:16,290

make methane on earth so you know the

553

00:25:19,730 --> 00:25:17,610

question is and there's been a lot of

554

00:25:21,950 --> 00:25:19,740

work in our field in astrobiology doing

555

00:25:24,920 --> 00:25:21,960

experiments right about taking cultures

556

00:25:27,260 --> 00:25:24,930

of these archaea obviously earth

557

00:25:29,780 --> 00:25:27,270

cultures of the archaea and growing them

558

00:25:33,830 --> 00:25:29,790

under these conditions that can mimic

559

00:25:35,810 --> 00:25:33,840

it's like on Mars or Enceladus and in

560

00:25:39,080 --> 00:25:35,820

fact they found you know some recent

561

00:25:42,320 --> 00:25:39,090

reports have found that you know some of

562

00:25:44,750 --> 00:25:42,330

these Earth's archaea can actually live

563

00:25:46,820 --> 00:25:44,760

under pretty close conditions to what

564

00:25:48,860 --> 00:25:46,830

you know we find on these other planets

565

00:25:51,380 --> 00:25:48,870

so it's really it's not kind of not

566

00:25:54,470 --> 00:25:51,390

crazy anymore to really think that hmm

567

00:25:58,220 --> 00:25:54,480

maybe maybe that could actually be like

568

00:25:59,960 --> 00:25:58,230

tiny trickle of little now I'm not

569

00:26:01,970 --> 00:25:59,970

saying obviously Mars is not like a

570

00:26:07,580 --> 00:26:01,980

flourishing ecosystem I think we can

571

00:26:10,250 --> 00:26:07,590

agree on that today but hey but the fact

572

00:26:13,630 --> 00:26:10,260

you know if there even is a tiny tiny

573

00:26:15,800 --> 00:26:13,640

low film somewhere that still

574

00:26:19,580 --> 00:26:15,810

fundamentally would change right our

575

00:26:22,310 --> 00:26:19,590

whole view on the universe right the

576

00:26:25,550 --> 00:26:22,320

underlying premise and I think it's I

577

00:26:30,530 --> 00:26:25,560

think a lot of given the excitement I've

578

00:26:32,920 --> 00:26:30,540

seen just amongst the public I think

579

00:26:36,350 --> 00:26:32,930

that a lot of us share that enthusiasm

580

00:26:38,520 --> 00:26:36,360

it's just such a inspiring time I think

581

00:26:41,910 --> 00:26:38,530

it's so it's so fun to be

582

00:26:44,040 --> 00:26:41,920

hang on something that just gets people

583

00:26:49,320 --> 00:26:44,050

excited that's a positive

584

00:26:51,570 --> 00:26:49,330

that's just mind bogglingly cool

585

00:26:54,390 --> 00:26:51,580

basically you know how fortunate we are

586

00:26:55,950 --> 00:26:54,400

so absolutely absolutely I think that's

587

00:26:57,150 --> 00:26:55,960

one of the reasons I like astrobiology

588

00:26:59,280 --> 00:26:57,160

so much is because all these

589

00:27:00,840 --> 00:26:59,290

philosophically repercussions about you

590

00:27:02,220 --> 00:27:00,850

know if we do find life else or what

591

00:27:03,660 --> 00:27:02,230

does that mean to be human and if we

592

00:27:05,970 --> 00:27:03,670

don't let what does that mean about our

593

00:27:08,520 --> 00:27:05,980

responsibilities of of stewardship you

594

00:27:10,980 --> 00:27:08,530

know it's very interesting and so you're

595

00:27:13,290 --> 00:27:10,990

a primarily a terrestrial biogeochemist

596

00:27:16,200 --> 00:27:13,300

but I know you're getting involved in

597

00:27:18,600 --> 00:27:16,210

some workshops and some groups that are

598

00:27:20,970 --> 00:27:18,610

discussing how to explore for life on

599

00:27:24,890 --> 00:27:20,980

icy worlds and those are moons of

600

00:27:27,600 --> 00:27:24,900

Jupiter like like like Europa

601
00:27:28,920 --> 00:27:27,610
wow how did I forget that and Enceladus

602
00:27:30,120 --> 00:27:28,930
which is a moon of Saturn of course

603
00:27:32,430 --> 00:27:30,130
could you tell us a little bit about

604
00:27:35,070 --> 00:27:32,440
your involvement and what are the

605
00:27:37,350 --> 00:27:35,080
thoughts there yes yes so I have an

606
00:27:40,470 --> 00:27:37,360
amazing colleague here at Georgia Tech

607
00:27:41,040 --> 00:27:40,480
who hopefully a lot of you already know

608
00:27:43,320 --> 00:27:41,050
about

609
00:27:47,850 --> 00:27:43,330
she's amazing is Brittany Schmidt here

610
00:27:49,800 --> 00:27:47,860
just just upstairs one level and ever

611
00:27:51,510 --> 00:27:49,810
since I've been here and I also got to

612
00:27:52,020 --> 00:27:51,520
know Brittany a bit because we have this

613
00:27:57,090 --> 00:27:52,030

amazing

614

00:27:59,250 --> 00:27:57,100

early career astrobiology community and

615

00:28:02,250 --> 00:27:59,260

so even before that I knew I knew her

616

00:28:04,410 --> 00:28:02,260

from our ab grad comms and things but

617

00:28:07,080 --> 00:28:04,420

working with Brittany here has just been

618

00:28:09,720 --> 00:28:07,090

amazing because you know her group is

619

00:28:12,570 --> 00:28:09,730

designing robots that could actually be

620

00:28:15,150 --> 00:28:12,580

used on your robot in the future when

621

00:28:17,580 --> 00:28:15,160

there's a Europa a lander mission which

622

00:28:20,130 --> 00:28:17,590

is in the works right in the in the

623

00:28:20,910 --> 00:28:20,140

future being planned and so they've got

624

00:28:22,680 --> 00:28:20,920

a plan

625

00:28:25,470 --> 00:28:22,690

they've got a you know go practice these

626

00:28:27,780 --> 00:28:25,480

things on earth so her group it has

627

00:28:29,850 --> 00:28:27,790

built this vehicle called ice bin I

628

00:28:32,190 --> 00:28:29,860

think it has a Twitter account and an

629

00:28:35,550 --> 00:28:32,200

Instagram account so go go search ice

630

00:28:37,290 --> 00:28:35,560

bin on the social media and you'll see a

631

00:28:38,130 --> 00:28:37,300

bunch of amazing pictures of them down

632

00:28:42,450 --> 00:28:38,140

in Antarctica

633

00:28:47,210 --> 00:28:42,460

so they're using under the Ross Ice

634

00:28:50,850 --> 00:28:47,220

Shelf as an analog for Europa and

635

00:28:52,530 --> 00:28:50,860

testing their their robot down there and

636

00:28:54,470 --> 00:28:52,540

looking at

637

00:28:58,320 --> 00:28:54,480

the conditions and habitability

638

00:29:01,289 --> 00:28:58,330

comparison to Europa and so I haven't

639

00:29:02,760 --> 00:29:01,299

been to Antarctica yet but I do get to

640

00:29:04,799 --> 00:29:02,770

play with the samples when they come

641

00:29:07,169 --> 00:29:04,809

back I get to help her graduate student

642

00:29:09,090 --> 00:29:07,179

Justin Lawrence with some of the

643

00:29:11,909 --> 00:29:09,100

analyses and so we'll be looking at the

644

00:29:15,510 --> 00:29:11,919

microbial ecology of those of those

645

00:29:19,320 --> 00:29:15,520

samples so we're told that and I was

646

00:29:21,930 --> 00:29:19,330

gonna mention also that my very I was

647

00:29:23,760 --> 00:29:21,940

gonna say Mike when I felt most like an

648

00:29:26,760 --> 00:29:23,770

astrobiologist was when I got to sit in

649

00:29:31,470 --> 00:29:26,770

on her conference call when she's some

650

00:29:34,710 --> 00:29:31,480

she's organizing a paper on the

651
00:29:39,000 --> 00:29:34,720
planetary protection of Europa and she's

652
00:29:42,150 --> 00:29:39,010
she's I either in charge of she's you

653
00:29:44,700 --> 00:29:42,160
know part of this community in charge of

654
00:29:47,190 --> 00:29:44,710
that and I just thought you know just

655
00:29:48,870 --> 00:29:47,200
the fact that I get to be sitting in on

656
00:29:50,610 --> 00:29:48,880
this conference call and author on this

657
00:29:55,770 --> 00:29:50,620
paper I get to be thinking about how to

658
00:29:57,990 --> 00:29:55,780
protect your ropa from cells coming from

659
00:30:00,570 --> 00:29:58,000
Earth I mean this is just surreal you

660
00:30:05,039 --> 00:30:00,580
know this is the best literally the best

661
00:30:09,780 --> 00:30:05,049
job you know ever so it's yeah I just

662
00:30:13,020 --> 00:30:09,790
can't say enough how fortunate and and

663
00:30:15,919 --> 00:30:13,030

that brings me to wanting to also help

664

00:30:18,870 --> 00:30:15,929

the next generation to become

665

00:30:20,669 --> 00:30:18,880

astrobiologists I will talk about that

666

00:30:23,039 --> 00:30:20,679

but we've been chatting for half an hour

667

00:30:24,690 --> 00:30:23,049

so I want to open up the floor to our

668

00:30:26,400 --> 00:30:24,700

audience who are who are watching and

669

00:30:29,159 --> 00:30:26,410

listening again if you have a question

670

00:30:30,690 --> 00:30:29,169

for dr. glass please use hashtag ask a

671

00:30:33,240 --> 00:30:30,700

strobe I on Twitter or ask the questions

672

00:30:36,240 --> 00:30:33,250

directly on the chat on Sega nerd org

673

00:30:37,830 --> 00:30:36,250

and the first question is it regards to

674

00:30:40,350 --> 00:30:37,840

the methane on Mars and it's from

675

00:30:42,600 --> 00:30:40,360

Michael Wong and he's curious how would

676
00:30:45,390 --> 00:30:42,610
you design a mission to be able to tell

677
00:30:53,520 --> 00:30:45,400
whether or not the methane is geologic

678
00:30:56,060 --> 00:30:53,530
or biology I think that this is this is

679
00:31:02,490 --> 00:30:56,070
coming up in future missions I imagine

680
00:31:04,470 --> 00:31:02,500
and so there are you know so I'll

681
00:31:06,269 --> 00:31:04,480
probably rely on some of you for help

682
00:31:07,709 --> 00:31:06,279
with this question too because

683
00:31:11,450 --> 00:31:07,719
I think this has been worked on so I

684
00:31:14,879 --> 00:31:11,460
don't want to mislead here but there's

685
00:31:17,459 --> 00:31:14,889
characteristic isotopic composition so

686
00:31:19,560 --> 00:31:17,469
the ratio of carbon so there's two

687
00:31:21,330 --> 00:31:19,570
different isotope just for those of you

688
00:31:26,940 --> 00:31:21,340

that I know we have a bunch of different

689

00:31:29,299 --> 00:31:26,950

backgrounds here right so the carbon in

690

00:31:32,129 --> 00:31:29,309

the central atom of methane right can be

691

00:31:34,820 --> 00:31:32,139

carbon-12 which is the more abundant or

692

00:31:38,489 --> 00:31:34,830

carbon 13 and the ratio of those two

693

00:31:39,869 --> 00:31:38,499

isotopes of carbon can be diagnostic for

694

00:31:40,950 --> 00:31:39,879

where the methane has come from

695

00:31:43,259 --> 00:31:40,960

especially if you can also

696

00:31:47,070 --> 00:31:43,269

simultaneously do a measurement of the

697

00:31:50,519 --> 00:31:47,080

hydrogen composition as well and so and

698

00:31:53,479 --> 00:31:50,529

I believe that's already being done or

699

00:31:57,570 --> 00:31:53,489

in the works I think some of that uh

700

00:32:01,200 --> 00:31:57,580

anybody help me out on this

701

00:32:02,999 --> 00:32:01,210

but so that is the isotopic

702

00:32:07,619 --> 00:32:03,009

composition is definitely something that

703

00:32:09,599 --> 00:32:07,629

would be important to do and also I was

704

00:32:11,729 --> 00:32:09,609

going to mention as well what I'm

705

00:32:15,329 --> 00:32:11,739

something else I'm really excited in

706

00:32:18,690 --> 00:32:15,339

about is drill is the drilling into the

707

00:32:20,969 --> 00:32:18,700

subsurface to see if we can and maybe

708

00:32:24,899 --> 00:32:20,979

not even drilling maybe just doing

709

00:32:27,299 --> 00:32:24,909

ground penetrating rate radar also to

710

00:32:29,959 --> 00:32:27,309

get really kind of better a better

711

00:32:32,789 --> 00:32:29,969

understanding of the methane hydrate

712

00:32:35,249 --> 00:32:32,799

structures as well because there's this

713

00:32:37,589 --> 00:32:35,259

hypothesis that the methane that we see

714

00:32:39,629 --> 00:32:37,599

this seasonal cycle might be coming from

715

00:32:41,969 --> 00:32:39,639

methane hydrates and I'm actually very

716

00:32:44,999 --> 00:32:41,979

interested in the methane hydrates as an

717

00:32:46,799 --> 00:32:45,009

ecosystem for organisms we are studying

718

00:32:50,129 --> 00:32:46,809

that in my lab right now because there's

719

00:32:52,529 --> 00:32:50,139

very unique communities that live only

720

00:32:54,029 --> 00:32:52,539

in methane hydrates and so if we can get

721

00:32:56,310 --> 00:32:54,039

you know there's gonna be sample return

722

00:32:59,009 --> 00:32:56,320

I don't know if we'll be able to get

723

00:33:01,440 --> 00:32:59,019

that methane cars nothin hydrate back

724

00:33:03,839 --> 00:33:01,450

that would be obviously the very best

725

00:33:05,849 --> 00:33:03,849

thing is to drill a chunk of that and

726

00:33:10,680 --> 00:33:05,859

then take it all the way back to earth

727

00:33:12,869 --> 00:33:10,690

and analyze the heck out of it but we

728

00:33:14,249 --> 00:33:12,879

probably might not be able to do that in

729

00:33:16,769 --> 00:33:14,259

our light although we might in our

730

00:33:19,560 --> 00:33:16,779

lifetime maybe fingers crossed that

731

00:33:19,860 --> 00:33:19,570

would be pretty great to be able to do

732

00:33:24,180 --> 00:33:19,870

so

733

00:33:28,530 --> 00:33:24,190

better understanding of the structure of

734

00:33:32,040 --> 00:33:28,540

the methane hydrates on Mars yeah that's

735

00:33:33,660 --> 00:33:32,050

still controversial the currents are

736

00:33:35,730 --> 00:33:33,670

over on Mars is not really a life

737

00:33:37,350 --> 00:33:35,740

detection Rover it's a actually

738

00:33:39,300 --> 00:33:37,360

environments mission and so perhaps a

739

00:33:41,610 --> 00:33:39,310

next generation of missions will be

740

00:33:45,450 --> 00:33:41,620

focused on life detection will include

741

00:33:47,580 --> 00:33:45,460

instruments the Mars that's my

742

00:33:49,650 --> 00:33:47,590

understanding from Mars 2020 right is

743

00:33:51,810 --> 00:33:49,660

that and forward from there is that

744

00:33:57,450 --> 00:33:51,820

we're moving in that direction right so

745

00:33:59,220 --> 00:33:57,460

okay beagle 2 which was a European

746

00:34:01,590 --> 00:33:59,230

Lander that unfortunately not make it

747

00:34:04,580 --> 00:34:01,600

had had such an instrument so we have to

748

00:34:07,110 --> 00:34:04,590

try and Mars is hard but we'll get to it

749

00:34:09,870 --> 00:34:07,120

the next question I think is one you

750

00:34:12,000 --> 00:34:09,880

want to touch on as well Luke is asking

751
00:34:13,920 --> 00:34:12,010
about hunks

752
00:34:15,900 --> 00:34:13,930
he's asking about some advice you would

753
00:34:18,830 --> 00:34:15,910
have for incoming students who are

754
00:34:23,040 --> 00:34:18,840
interested in a career in astrobiology

755
00:34:26,310 --> 00:34:23,050
yes well first of all thank you for your

756
00:34:29,450 --> 00:34:26,320
interest and welcome and and we are

757
00:34:33,960 --> 00:34:29,460
interested in you being on board and so

758
00:34:35,790 --> 00:34:33,970
by all means join Sagan net this is

759
00:34:39,030 --> 00:34:35,800
being hosted through so you should have

760
00:34:41,640 --> 00:34:39,040
easy access to the website there and

761
00:34:44,190 --> 00:34:41,650
link up with a mentor because the very

762
00:34:45,960 --> 00:34:44,200
most important thing even if you're say

763
00:34:48,690 --> 00:34:45,970

you're at a university that doesn't have

764

00:34:51,270 --> 00:34:48,700

as far as you know any astrobiology

765

00:34:53,490 --> 00:34:51,280

let's assume you know that you can't

766

00:34:56,040 --> 00:34:53,500

really find anybody that's interested in

767

00:34:57,900 --> 00:34:56,050

it best case there's tons of people and

768

00:35:00,330 --> 00:34:57,910

it's gonna be easier but let's say you

769

00:35:02,970 --> 00:35:00,340

don't have access to that then you're

770

00:35:05,070 --> 00:35:02,980

gonna need to rely much more on the

771

00:35:08,040 --> 00:35:05,080

internet but you have hopefully the

772

00:35:11,880 --> 00:35:08,050

internet fairly available at your

773

00:35:13,800 --> 00:35:11,890

fingertips and so get on you know that's

774

00:35:16,770 --> 00:35:13,810

the beauty of having social media now is

775

00:35:19,860 --> 00:35:16,780

that I'm always on Twitter and so who

776

00:35:22,200 --> 00:35:19,870

are a lot of us and if product and say

777

00:35:23,820 --> 00:35:22,210

your net as well and so get a mentor

778

00:35:28,830 --> 00:35:23,830

through there

779

00:35:30,630 --> 00:35:28,840

to email now that I am well I'm not

780

00:35:32,640 --> 00:35:30,640

through the tenure process I'm up for

781

00:35:34,650 --> 00:35:32,650

tenure as we speak

782

00:35:36,900 --> 00:35:34,660

fingers crossed Mike can your baguette

783

00:35:38,760 --> 00:35:36,910

so I keep saying I'm gonna do it after

784

00:35:40,380 --> 00:35:38,770

tenure that's what we all say right so I

785

00:35:43,110 --> 00:35:40,390

have a lot of things to do now after ten

786

00:35:46,350 --> 00:35:43,120

years so I would love to do more

787

00:35:51,840 --> 00:35:46,360

mentoring as well hold me to that Sandra

788

00:35:54,120 --> 00:35:51,850

I will so but yeah so that's like

789

00:35:56,700 --> 00:35:54,130

scenario if you do not already have a

790

00:35:59,160 --> 00:35:56,710

program now on Sagan that you can see

791

00:36:01,290 --> 00:35:59,170

there are a bunch of universities in the

792

00:36:04,110 --> 00:36:01,300

US and internationally that do have

793

00:36:06,270 --> 00:36:04,120

programs and so by all means ask your

794

00:36:09,210 --> 00:36:06,280

professors some of them might be like

795

00:36:10,980 --> 00:36:09,220

you know you know some people the first

796

00:36:13,350 --> 00:36:10,990

time they hear us for biology they think

797

00:36:14,990 --> 00:36:13,360

you know we're they don't quite

798

00:36:17,550 --> 00:36:15,000

understand what it's about we have to

799

00:36:21,090 --> 00:36:17,560

teach them that it's not little green

800

00:36:23,820 --> 00:36:21,100

man or anything but hopefully you can

801
00:36:26,730 --> 00:36:23,830
find you know regardless of what you end

802
00:36:30,090 --> 00:36:26,740
up doing in your career having the

803
00:36:32,640 --> 00:36:30,100
mentors is so so so essential that's the

804
00:36:36,030 --> 00:36:32,650
one thing I've learned and my my life is

805
00:36:38,490 --> 00:36:36,040
how essential it is so you know really

806
00:36:40,710 --> 00:36:38,500
get you know for the classes that you're

807
00:36:43,050 --> 00:36:40,720
really interested in going to the office

808
00:36:44,880 --> 00:36:43,060
hours asking to work in the labs if

809
00:36:48,600 --> 00:36:44,890
you're really interested in that group

810
00:36:50,040 --> 00:36:48,610
by all means you know ask to work if

811
00:36:51,840 --> 00:36:50,050
they have a research lab which you could

812
00:36:54,030 --> 00:36:51,850
work in that research lab and get some

813
00:36:56,490 --> 00:36:54,040

research experience and then that'll

814

00:36:58,710 --> 00:36:56,500

just kind of snowball from there you can

815

00:37:00,840 --> 00:36:58,720

do summer programs right you can do our

816

00:37:03,330 --> 00:37:00,850

use and there's astrobiology summer

817

00:37:04,740 --> 00:37:03,340

programs you can apply to so but you

818

00:37:07,110 --> 00:37:04,750

need to kind of get your foot in the

819

00:37:09,750 --> 00:37:07,120

door and what I want to emphasize is

820

00:37:12,870 --> 00:37:09,760

that that foot in the door does not have

821

00:37:14,370 --> 00:37:12,880

to be a program at your University

822

00:37:16,260 --> 00:37:14,380

because that's gonna limit a lot of

823

00:37:18,270 --> 00:37:16,270

people from getting in the door right

824

00:37:19,950 --> 00:37:18,280

because there's something like 20 or 30

825

00:37:21,390 --> 00:37:19,960

programs we're starting one here at

826

00:37:23,670 --> 00:37:21,400

Georgia Tech but there's other places

827

00:37:26,490 --> 00:37:23,680

that might not so by all means get your

828

00:37:28,550 --> 00:37:26,500

foot in the door online if you don't if

829

00:37:30,660 --> 00:37:28,560

you don't see your university up there

830

00:37:33,450 --> 00:37:30,670

obviously you know you see a lot of

831

00:37:36,660 --> 00:37:33,460

University of ba-ba-ba-ba-ba but there

832

00:37:40,080 --> 00:37:36,670

are many many many more schools and you

833

00:37:41,160 --> 00:37:40,090

know we recognize that and and there's

834

00:37:43,110 --> 00:37:41,170

one thing I've learned about this

835

00:37:45,750 --> 00:37:43,120

community this astrobiology community is

836

00:37:47,849 --> 00:37:45,760

how inclusive it is how

837

00:37:51,060 --> 00:37:47,859

- its early career people and how

838

00:37:55,800 --> 00:37:51,070

amazingly inclusive and welcoming it is

839

00:37:58,200 --> 00:37:55,810

and that's something to be really really

840

00:38:00,540 --> 00:37:58,210

proud of and to really really want to

841

00:38:03,060 --> 00:38:00,550

keep keep going and we have amazing

842

00:38:07,859 --> 00:38:03,070

people to leadership in this community

843

00:38:11,040 --> 00:38:07,869

to thank for really fostering that so so

844

00:38:14,760 --> 00:38:11,050

yeah come to a second net and oh I'll

845

00:38:16,620 --> 00:38:14,770

try to mentor I want to return your

846

00:38:18,720 --> 00:38:16,630

shoutouts to you Jennifer because you

847

00:38:21,450 --> 00:38:18,730

are very active in promoting diversity

848

00:38:22,560 --> 00:38:21,460

and science and women in science I was

849

00:38:25,140 --> 00:38:22,570

wondering if you could tell us a bit

850

00:38:29,340 --> 00:38:25,150

more about these these efforts that

851
00:38:31,500 --> 00:38:29,350
you're doing yeah so a lot of those had

852
00:38:36,060 --> 00:38:31,510
to do honestly I'll just be very candid

853
00:38:38,640 --> 00:38:36,070
I guess with um me white woman not I'd

854
00:38:41,130 --> 00:38:38,650
say white feminist five years ago kind

855
00:38:42,750 --> 00:38:41,140
of moving to Atlanta and learning a lot

856
00:38:45,480 --> 00:38:42,760
in the process

857
00:38:48,120 --> 00:38:45,490
I honestly you know grew up in Olympia

858
00:38:52,380 --> 00:38:48,130
it's a very pretty kind of white small

859
00:38:55,740 --> 00:38:52,390
town there were not there was not much

860
00:38:57,599 --> 00:38:55,750
diversity in my most of the programs

861
00:39:00,960 --> 00:38:57,609
where I was in school and I was pretty

862
00:39:03,810 --> 00:39:00,970
oblivious to that in what I was more

863
00:39:05,010 --> 00:39:03,820

passionate was kind of feminism but I'm

864

00:39:07,410 --> 00:39:05,020

gonna be honest and say it was probably

865

00:39:09,480 --> 00:39:07,420

a pretty white feminism looking back on

866

00:39:11,910 --> 00:39:09,490

it cuz I wasn't thinking very broadly

867

00:39:14,280 --> 00:39:11,920

like now I don't say women and

868

00:39:16,320 --> 00:39:14,290

minorities I say white women and you

869

00:39:18,560 --> 00:39:16,330

know cuz that's true it's it's white

870

00:39:21,510 --> 00:39:18,570

women and minorities otherwise you're

871

00:39:23,340 --> 00:39:21,520

you know assuming that women are white

872

00:39:27,690 --> 00:39:23,350

women and there's a lot more women than

873

00:39:31,170 --> 00:39:27,700

just white women so so it's basically

874

00:39:36,630 --> 00:39:31,180

been me trying to learn ever since I

875

00:39:38,220 --> 00:39:36,640

moved to Atlanta really trying to first

876

00:39:41,220 --> 00:39:38,230

of all learn cuz I had a lot to learn

877

00:39:44,580 --> 00:39:41,230

and then trying to change the system

878

00:39:49,230 --> 00:39:44,590

which i rapidly learned and learning how

879

00:39:50,580 --> 00:39:49,240

how challenging that can be but also but

880

00:39:53,070 --> 00:39:50,590

I think it's really important for me to

881

00:39:54,810 --> 00:39:53,080

understand how challenging that isn't

882

00:39:56,849 --> 00:39:54,820

just in the in the process of kind of

883

00:39:58,600 --> 00:39:56,859

talking about how challenging it is I

884

00:40:01,150 --> 00:39:58,610

think that back

885

00:40:04,300 --> 00:40:01,160

maybe that can be really productive

886

00:40:07,240 --> 00:40:04,310

maybe in and of itself is talking about

887

00:40:09,700 --> 00:40:07,250

what the barriers are and for me to

888

00:40:12,160 --> 00:40:09,710

understand what those barriers are as

889

00:40:15,160 --> 00:40:12,170

well a lot of times maybe the barriers

890

00:40:18,010 --> 00:40:15,170

are hidden from those of us who you know

891

00:40:19,810 --> 00:40:18,020

especially frankly white people those

892

00:40:21,250 --> 00:40:19,820

there they might not see those barriers

893

00:40:25,270 --> 00:40:21,260

they probably don't see those barriers

894

00:40:27,520 --> 00:40:25,280

so you know first of all learning about

895

00:40:30,490 --> 00:40:27,530

those barriers and how to them basically

896

00:40:31,990 --> 00:40:30,500

rip them down that's part of those

897

00:40:35,430 --> 00:40:32,000

saving to planet efforts so you're

898

00:40:39,820 --> 00:40:38,170

so talk to you a little bit about those

899

00:40:42,340 --> 00:40:39,830

methane hydrates cause they're super

900

00:40:44,110 --> 00:40:42,350

interesting could you describe what what

901
00:40:47,050 --> 00:40:44,120
what are methane hydrates to begin with

902
00:40:49,240 --> 00:40:47,060
oh yes yes I love methane hydrates I've

903
00:40:51,820 --> 00:40:49,250
been in love with methane hydrates ever

904
00:40:54,040 --> 00:40:51,830
since I was at University of Washington

905
00:40:56,260 --> 00:40:54,050
I actually got assigned to write a term

906
00:40:57,700 --> 00:40:56,270
paper on them and I fell in love with

907
00:40:59,680 --> 00:40:57,710
them then and I was determined to work

908
00:41:02,620 --> 00:40:59,690
on them and I got to and I got to be

909
00:41:05,440 --> 00:41:02,630
like six years later as a postdoc I got

910
00:41:08,380 --> 00:41:05,450
to actually CDs of what are these these

911
00:41:11,350 --> 00:41:08,390
are basically that it's basically ice

912
00:41:15,700 --> 00:41:11,360
it's water ice but it's it's a cage of

913
00:41:17,440 --> 00:41:15,710

water ice at encasing methane molecules

914

00:41:19,390 --> 00:41:17,450

and they're packed together so it

915

00:41:22,450 --> 00:41:19,400

basically looks like ice but it's got

916

00:41:26,110 --> 00:41:22,460

methane in the middle and these occur

917

00:41:31,240 --> 00:41:26,120

under low temperatures and high

918

00:41:33,940 --> 00:41:31,250

pressures so on earth they are in the

919

00:41:37,360 --> 00:41:33,950

mud and the sea floor under the sea

920

00:41:39,790 --> 00:41:37,370

floor of continental slopes basically

921

00:41:43,690 --> 00:41:39,800

like you can just go right out off of

922

00:41:47,380 --> 00:41:43,700

the Carolinas and see them maybe not see

923

00:41:49,240 --> 00:41:47,390

them but if you go down to the sea floor

924

00:41:51,880 --> 00:41:49,250

you might see them and then especially

925

00:41:53,770 --> 00:41:51,890

off the west coast right off of where we

926
00:41:56,140 --> 00:41:53,780
were right up or again there's just

927
00:42:00,580 --> 00:41:56,150
that's the system I've been working on

928
00:42:01,960 --> 00:42:00,590
ever since I was a postdoc and that I've

929
00:42:03,550 --> 00:42:01,970
probably continued to work on it my

930
00:42:05,260 --> 00:42:03,560
whole life because they're just so many

931
00:42:07,540 --> 00:42:05,270
discoveries to be made there especially

932
00:42:09,640 --> 00:42:07,550
about what's happening with the microbes

933
00:42:11,790 --> 00:42:09,650
that are living in the methane you know

934
00:42:14,760 --> 00:42:11,800
we've studied there's whole groups

935
00:42:17,010 --> 00:42:14,770
like Victoria orphans group and it has

936
00:42:19,580 --> 00:42:17,020
done amazing work on the communities

937
00:42:22,350 --> 00:42:19,590
that are right at that seawater

938
00:42:24,060 --> 00:42:22,360

interface that are oxidizing the methane

939

00:42:28,790 --> 00:42:24,070

that's coming up through the seafloor

940

00:42:30,630 --> 00:42:28,800

and so we cuz I'm glutton for punishment

941

00:42:34,620 --> 00:42:30,640

wanted to figure out what was happening

942

00:42:36,720 --> 00:42:34,630

like you know seven meters down beneath

943

00:42:38,760 --> 00:42:36,730

it and actually were able to get samples

944

00:42:44,310 --> 00:42:38,770

from the international ocean drilling

945

00:42:45,660 --> 00:42:44,320

program of some of the sediments that

946

00:42:48,840 --> 00:42:45,670

had hydrate in them

947

00:42:53,130 --> 00:42:48,850

hydrate had long since dissipated but

948

00:42:56,520 --> 00:42:53,140

the DNA from the the microbial cells was

949

00:42:58,710 --> 00:42:56,530

still in the mud DNA actually lasts a

950

00:43:01,310 --> 00:42:58,720

really long time if you keep it you know

951
00:43:04,980 --> 00:43:01,320
really if you if you preserve it right

952
00:43:08,340 --> 00:43:04,990
and so we've been studying I've been

953
00:43:10,890 --> 00:43:08,350
studying those genomes for year

954
00:43:13,700 --> 00:43:10,900
literally years because it was not the

955
00:43:17,130 --> 00:43:13,710
answer the you know we were expecting

956
00:43:19,230 --> 00:43:17,140
naively I was expecting to get this

957
00:43:20,970 --> 00:43:19,240
beautiful signature of all these genes

958
00:43:22,680 --> 00:43:20,980
in the methane cycle and it was gonna

959
00:43:24,810 --> 00:43:22,690
make perfect sense and they were all

960
00:43:29,850 --> 00:43:24,820
these novel claims we're gonna be making

961
00:43:37,950 --> 00:43:29,860
methane and end of story right but my in

962
00:43:41,850 --> 00:43:37,960
in my scientific career I tend to wrong

963
00:43:44,520 --> 00:43:41,860

and so sure enough that I couldn't find

964

00:43:45,930 --> 00:43:44,530

any methane related genes in there so

965

00:43:47,430 --> 00:43:45,940

now we're trying to where what we've

966

00:43:49,170 --> 00:43:47,440

been doing is constructing this

967

00:43:52,110 --> 00:43:49,180

completely different story

968

00:43:53,700 --> 00:43:52,120

about something I really knew very very

969

00:43:56,100 --> 00:43:53,710

little about and kind of hush-hush about

970

00:43:59,970 --> 00:43:56,110

it because we haven't well really it's

971

00:44:03,150 --> 00:43:59,980

because I'm I want peer reviewers to bet

972

00:44:05,160 --> 00:44:03,160

for it before I put it out there because

973

00:44:07,650 --> 00:44:05,170

it's really it's it's really fascinating

974

00:44:10,530 --> 00:44:07,660

but basically it comes down to you know

975

00:44:11,250 --> 00:44:10,540

how do microbes survive in essentially

976
00:44:14,400 --> 00:44:11,260
brines

977
00:44:16,440 --> 00:44:14,410
right in in in these little pockets

978
00:44:18,240 --> 00:44:16,450
these little water pockets amongst the

979
00:44:22,040 --> 00:44:18,250
methane hydrate we just kind of actually

980
00:44:23,910 --> 00:44:22,050
a pretty amazing analog for perhaps

981
00:44:28,230 --> 00:44:23,920
subsurface

982
00:44:31,260 --> 00:44:28,240
Mars or other other planetary bodies and

983
00:44:33,330 --> 00:44:31,270
so it's pretty exciting yeah indeed and

984
00:44:35,220 --> 00:44:33,340
one might think of methane clathrates as

985
00:44:36,840 --> 00:44:35,230
being this specialized topic but they're

986
00:44:38,490 --> 00:44:36,850
usually important for the climate on

987
00:44:40,050 --> 00:44:38,500
earth right because they contain the

988
00:44:41,970 --> 00:44:40,060

methane that is a very powerful

989

00:44:43,620 --> 00:44:41,980

greenhouse gas and because it contained

990

00:44:45,690 --> 00:44:43,630

an ice on the sea floor as the ocean

991

00:44:47,220 --> 00:44:45,700

goes up those could be released so they

992

00:44:49,200 --> 00:44:47,230

would have some dramatic impact on the

993

00:44:51,240 --> 00:44:49,210

climate right and they're also being

994

00:44:53,310 --> 00:44:51,250

absolutely yes that's true and they're

995

00:44:56,880 --> 00:44:53,320

also being looked into actually by

996

00:44:58,830 --> 00:44:56,890

countries like Japan and Norway or who

997

00:45:02,820 --> 00:44:58,840

have long coastlines and don't have very

998

00:45:06,500 --> 00:45:02,830

much fossil fuels - as potentially an

999

00:45:08,610 --> 00:45:06,510

energy source in the future as well now

1000

00:45:11,520 --> 00:45:08,620

speaking of controversial you know

1001
00:45:13,440 --> 00:45:11,530
that's certainly controversial but you

1002
00:45:18,570 --> 00:45:13,450
know it's probably it's in the process

1003
00:45:20,400 --> 00:45:18,580
of happening so yeah I stay aware of

1004
00:45:23,010 --> 00:45:20,410
methane clathrates in the news folks

1005
00:45:24,780 --> 00:45:23,020
because that's a big deal but returning

1006
00:45:27,360 --> 00:45:24,790
to the questions I could ask so many of

1007
00:45:30,210 --> 00:45:27,370
them um there's a question from Marnie

1008
00:45:31,950 --> 00:45:30,220
who asks about partly the paper that

1009
00:45:33,630 --> 00:45:31,960
came out stating that the there's

1010
00:45:35,430 --> 00:45:33,640
possibility of life on the moon three

1011
00:45:38,030 --> 00:45:35,440
and a half billion years ago what are

1012
00:45:40,740 --> 00:45:38,040
your thoughts on life on the moon oh

1013
00:45:45,480 --> 00:45:40,750

goodness

1014

00:45:47,430 --> 00:45:45,490

I don't know that paper and I will have

1015

00:45:49,740 --> 00:45:47,440

to look at that because I don't honestly

1016

00:45:51,630 --> 00:45:49,750

know that papers she goes to show that I

1017

00:45:54,570 --> 00:45:51,640

as a professor don't always keep a lot

1018

00:45:58,370 --> 00:45:54,580

of turquoise well I did it's a student

1019

00:46:01,680 --> 00:45:58,380

so much cool stuff but I guess

1020

00:46:05,060 --> 00:46:01,690

potentially I don't know I guess is do

1021

00:46:09,050 --> 00:46:05,070

you know this paper or anything about it

1022

00:46:12,390 --> 00:46:09,060

the impact that kind of created the moon

1023

00:46:17,100 --> 00:46:12,400

before then whether life could have

1024

00:46:19,890 --> 00:46:17,110

emerged on the moon kind of in in

1025

00:46:21,950 --> 00:46:19,900

knowing in 100s of millions and years

1026

00:46:26,250 --> 00:46:21,960

after that they said three point five

1027

00:46:27,950 --> 00:46:26,260

yeah my guess is that yeah maybe it's

1028

00:46:30,270 --> 00:46:27,960

because you know there's there's this

1029

00:46:31,980 --> 00:46:30,280

hypothesis that during you know around

1030

00:46:33,810 --> 00:46:31,990

that time period is a period called the

1031

00:46:36,240 --> 00:46:33,820

late heavy bombardment on earth and

1032

00:46:37,560 --> 00:46:36,250

those large meteor strikes could you

1033

00:46:39,390 --> 00:46:37,570

know throw out rocks

1034

00:46:42,030 --> 00:46:39,400

from the earth into the solar system and

1035

00:46:43,350 --> 00:46:42,040

those rocks on earth earth was very much

1036

00:46:45,270 --> 00:46:43,360

alive you know it's really half million

1037

00:46:46,500 --> 00:46:45,280

years ago so maybe those rocks then

1038

00:46:48,930 --> 00:46:46,510

impacted the moon that could potentially

1039

00:46:56,250 --> 00:46:48,940

see the moon but there's just no watch

1040

00:46:59,370 --> 00:46:56,260

on the moon actually I've heard that

1041

00:47:01,740 --> 00:46:59,380

hypothesis before yeah so whether that's

1042

00:47:03,930 --> 00:47:01,750

actually growing on the moon at the time

1043

00:47:06,390 --> 00:47:03,940

or whether it was kind of ejected and

1044

00:47:08,370 --> 00:47:06,400

then I ended up on the moon and but I'll

1045

00:47:12,870 --> 00:47:08,380

have to check out that paper so sorry I

1046

00:47:15,510 --> 00:47:12,880

can't comment more on that it's an

1047

00:47:18,450 --> 00:47:15,520

interesting there's a question by dr.

1048

00:47:20,730 --> 00:47:18,460

Graham Lau hi Graham who asks what is

1049

00:47:32,580 --> 00:47:20,740

your favorite living thing on the earth

1050

00:47:36,870 --> 00:47:32,590

and why question I mean I love the

1051
00:47:39,210 --> 00:47:36,880
microbes but you know I'm such a

1052
00:47:41,640 --> 00:47:39,220
westcoast er I think I probably have to

1053
00:47:43,800 --> 00:47:41,650
say a tree I'd probably say the redwoods

1054
00:47:48,240 --> 00:47:43,810
you know I'd probably say the dawn

1055
00:47:51,150 --> 00:47:48,250
redwood because it was thought to be

1056
00:47:54,560 --> 00:47:51,160
extinct right it's this this really kind

1057
00:47:56,970 --> 00:47:54,570
of prehistoric looking redwood

1058
00:47:58,440 --> 00:47:56,980
subspecies I believe I think the dawn

1059
00:47:59,850 --> 00:47:58,450
redwood is my father that's just what

1060
00:48:03,420 --> 00:47:59,860
I'm coming up with off the top of my

1061
00:48:05,130 --> 00:48:03,430
head but I do love the microbes I'm

1062
00:48:06,900 --> 00:48:05,140
especially excited right now about beta

1063
00:48:10,230 --> 00:48:06,910

proteobacteria and who really you know

1064

00:48:15,420 --> 00:48:10,240

get a bad rap I think I mean but thank

1065

00:48:18,210 --> 00:48:15,430

you thank you stupid you know bring make

1066

00:48:22,770 --> 00:48:18,220

Veda Proteobacteria cool again or

1067

00:48:26,370 --> 00:48:22,780

something there's a question I think

1068

00:48:29,610 --> 00:48:26,380

that I saw briefly about the possibility

1069

00:48:32,360 --> 00:48:29,620

that we one would not have to drill into

1070

00:48:36,240 --> 00:48:32,370

Europa to find a possibility of life

1071

00:48:37,290 --> 00:48:36,250

about life detection on Europa yes yes

1072

00:48:40,170 --> 00:48:37,300

I'll do my best

1073

00:48:43,590 --> 00:48:40,180

this is Brittany's habitat but but my

1074

00:48:45,900 --> 00:48:43,600

understanding is that the Clipper you

1075

00:48:49,500 --> 00:48:45,910

know which will when is that happening

1076

00:48:50,599 --> 00:48:49,510

in the not to do is from Yale right a

1077

00:48:52,729 --> 00:48:50,609

couple years from now

1078

00:48:56,229 --> 00:48:52,739

is going to be able to assess whether

1079

00:48:58,849 --> 00:48:56,239

there might be pockets actually of water

1080

00:49:00,309 --> 00:48:58,859

in the ice so that we wouldn't have to

1081

00:49:02,359 --> 00:49:00,319

is that correct

1082

00:49:04,700 --> 00:49:02,369

so that we wouldn't have to drill all

1083

00:49:06,829 --> 00:49:04,710

the way down you know into through the

1084

00:49:08,779 --> 00:49:06,839

ice all the way to the ocean but could

1085

00:49:15,049 --> 00:49:08,789

actually you know potentially these

1086

00:49:17,359 --> 00:49:15,059

little pockets of water that might like

1087

00:49:21,349 --> 00:49:17,369

I was talking about before you know

1088

00:49:24,380 --> 00:49:21,359

these little pockets of water you know

1089

00:49:28,460 --> 00:49:24,390

it could be potential habitats right and

1090

00:49:30,829 --> 00:49:28,470

so maybe that's what you know but they

1091

00:49:32,390 --> 00:49:30,839

we have to be careful too because we

1092

00:49:33,769 --> 00:49:32,400

have to make sure arts whatever we're

1093

00:49:35,690 --> 00:49:33,779

sending to Europe it doesn't start

1094

00:49:38,299 --> 00:49:35,700

growing in those little pockets or else

1095

00:49:42,650 --> 00:49:38,309

we'll get beta program on earth made a

1096

00:49:44,720 --> 00:49:42,660

Proteobacteria azaria sir yeah that will

1097

00:49:47,900 --> 00:49:44,730

do a good job in that they won't survive

1098

00:49:48,799 --> 00:49:47,910

the flight anyway but you know you have

1099

00:49:52,370 --> 00:49:48,809

to let people

1100

00:49:53,509 --> 00:49:52,380

telogen just to make sure yeah a lot of

1101

00:49:55,279 --> 00:49:53,519

people are thinking about that problem

1102

00:49:56,839 --> 00:49:55,289

it's very important and I mean if you

1103

00:49:58,099 --> 00:49:56,849

look at the the surface of Europe by

1104

00:50:00,410 --> 00:49:58,109

it's all cracked and there's evidence

1105

00:50:03,859 --> 00:50:00,420

for overturning so the ice is not static

1106

00:50:06,589 --> 00:50:03,869

static it's definitely moving and we had

1107

00:50:08,630 --> 00:50:06,599

dr. dr. Schmitz on ask an astrobiologist

1108

00:50:10,039 --> 00:50:08,640

I think he's old 11 if I remember right

1109

00:50:13,640 --> 00:50:10,049

it was her it was a wonderful

1110

00:50:16,759 --> 00:50:13,650

conversation on life on ice use because

1111

00:50:20,359 --> 00:50:16,769

dr. Schmidt has a new center here called

1112

00:50:22,339 --> 00:50:20,369

oceans across space and time and I'm I'm

1113

00:50:23,749 --> 00:50:22,349

proud to be a member of that and so

1114

00:50:25,210 --> 00:50:23,759

they'll be doing a lot more work on that

1115

00:50:27,170 --> 00:50:25,220

here at Georgia Tech

1116

00:50:33,440 --> 00:50:27,180

I'm involved in that too and I'm very

1117

00:50:37,729 --> 00:50:33,450

excited so we're getting close to the

1118

00:50:40,849 --> 00:50:37,739

hour out is a new question what is the

1119

00:50:43,489 --> 00:50:40,859

Twitter handles of ice fin I think it's

1120

00:50:46,460 --> 00:50:43,499

just at ice fin right this summer and

1121

00:50:48,650 --> 00:50:46,470

Mikey boy is asking that is that right

1122

00:50:53,150 --> 00:50:48,660

the Twitter handle for you I mean oh

1123

00:51:00,470 --> 00:50:53,160

look I can look it's all good we'll put

1124

00:51:02,930 --> 00:51:00,480

it on the on the chat wow yeah yeah no

1125

00:51:04,480 --> 00:51:02,940

no I got it I got it I spit at I spin

1126

00:51:14,120 --> 00:51:04,490

robot

1127

00:51:15,680 --> 00:51:14,130

yeah Instagram or Facebook - there's an

1128

00:51:18,350 --> 00:51:15,690

is that I think there's a nice last

1129

00:51:20,180 --> 00:51:18,360

question here by Kavita who asked is

1130

00:51:22,820 --> 00:51:20,190

what isn't is not attached to university

1131

00:51:25,070 --> 00:51:22,830

but still interested in astrobiology um

1132

00:51:27,950 --> 00:51:25,080

how can one get you know more

1133

00:51:31,670 --> 00:51:27,960

information get more involved yeah and

1134

00:51:33,800 --> 00:51:31,680

so I would say again social media

1135

00:51:36,110 --> 00:51:33,810

because we all talk on there all the

1136

00:51:38,690 --> 00:51:36,120

time and it's a very inclusive community

1137

00:51:41,720 --> 00:51:38,700

and by all means I mean I ask questions

1138

00:51:44,450 --> 00:51:41,730

all the time to the whole who has ever

1139

00:51:46,630 --> 00:51:44,460

listening on the Twitter's and it's

1140

00:51:49,460 --> 00:51:46,640

amazing people will just end and

1141

00:51:50,660 --> 00:51:49,470

sometimes I don't even know they don't

1142

00:51:52,880 --> 00:51:50,670

even have their you don't even have to

1143

00:51:55,160 --> 00:51:52,890

use your room right so sometimes people

1144

00:51:56,810 --> 00:51:55,170

just come out of the woodwork and just

1145

00:51:59,660 --> 00:51:56,820

have the most amazing questions and

1146

00:52:02,210 --> 00:51:59,670

answers so by all means please please be

1147

00:52:05,570 --> 00:52:02,220

involved in and you know you can go

1148

00:52:07,910 --> 00:52:05,580

through by tagging say Gannett you could

1149

00:52:11,200 --> 00:52:07,920

or is it sagan org that's your handle

1150

00:52:14,060 --> 00:52:11,210

yeah that might be a good way or hashtag

1151

00:52:17,630 --> 00:52:14,070

astrobiology right or tag me and own

1152

00:52:19,400 --> 00:52:17,640

retweet it so that's I guess that's what

1153

00:52:22,040 --> 00:52:19,410

I'd say just the simple answer and then

1154

00:52:30,590 --> 00:52:22,050

from that obviously you can also get

1155

00:52:33,680 --> 00:52:30,600

directed to well Sagan net or abside

1156

00:52:35,840 --> 00:52:33,690

Khan and have grad con depending on you

1157

00:52:37,760 --> 00:52:35,850

know if you are thinking but being a

1158

00:52:43,220 --> 00:52:37,770

student or kind of associated with

1159

00:52:45,230 --> 00:52:43,230

schools that would be AB grad Khan so I

1160

00:52:47,360 --> 00:52:45,240

don't know social media is just gonna be

1161

00:52:48,680 --> 00:52:47,370

my answer mostly there but if that's the

1162

00:52:50,420 --> 00:52:48,690

place you can get your foot in the door

1163

00:52:52,430 --> 00:52:50,430

right and then kind of go from there

1164

00:52:54,530 --> 00:52:52,440

there's lots of opportunities of of

1165

00:52:57,020 --> 00:52:54,540

different summer schools and things as

1166

00:52:58,550 --> 00:52:57,030

well and you're very active on Twitter I

1167

00:53:00,790 --> 00:52:58,560

know that for a fact you tweet does

1168

00:53:04,970 --> 00:53:00,800

activate former

1169

00:53:06,860 --> 00:53:04,980

je and at the end and then I I know

1170

00:53:08,420 --> 00:53:06,870

you're extremely busy scientist has been

1171

00:53:10,160 --> 00:53:08,430

clear in this conversation and I'm so

1172

00:53:11,450 --> 00:53:10,170

grateful that you took the time to chat

1173

00:53:13,580 --> 00:53:11,460

with us today it was a wonderful

1174

00:53:16,310 --> 00:53:13,590

conversation for those of you who are

1175

00:53:17,420 --> 00:53:16,320

watching make sure you keep looking at

1176

00:53:19,040 --> 00:53:17,430

Twitter for more

1177

00:53:22,040 --> 00:53:19,050

updates and if you have any questions

1178

00:53:23,540 --> 00:53:22,050

for us put it there and look forward to

1179

00:53:26,000 --> 00:53:23,550

our another episode of ask and

1180

00:53:27,380 --> 00:53:26,010

astrobiologists and Jen any last words

1181

00:53:31,099 --> 00:53:27,390

of wisdom before we close the doors

1182

00:53:33,079 --> 00:53:31,109

today have you banded iron formations so

1183

00:53:35,120 --> 00:53:33,089

you can I think it chance to talk about

1184

00:53:38,980 --> 00:53:35,130

these but these are proof that there was

1185

00:53:41,299 --> 00:53:38,990

really a lot of iron in the ocean

1186

00:53:43,520 --> 00:53:41,309

billions of years ago and so I'll just

1187

00:53:49,790 --> 00:53:43,530

say goodbye with the banded iron

1188

00:53:51,950 --> 00:53:49,800

formations best goodbye prop ever

1189

00:53:53,900 --> 00:53:51,960

everyone I wish you all a wonderful week

1190

00:53:55,940 --> 00:53:53,910

month and we'll see you next time on ask

1191

00:53:56,450 --> 00:53:55,950

and astrobiologist until then do stay

1192

00:53:57,590 --> 00:53:56,460

curious