



# ASK AN ASTROBIOLOGIST

EPISODE 54: JANUARY 30, 2023

**DR. SANJOY SOM**

**#ASKASTROBIO**

The NASA logo, featuring the word "NASA" in white capital letters inside a blue circular emblem with a red swoosh and a white star.

1  
00:00:01,830 --> 00:00:00,470  
[Music]

2  
00:00:22,730 --> 00:00:01,840  
foreign

3  
00:00:23,970 --> 00:00:22,740  
[Music]

4  
00:00:41,950 --> 00:00:23,980  
[Applause]

5  
00:00:44,690 --> 00:00:41,960  
[Music]

6  
00:00:46,430 --> 00:00:44,700  
friends and fellow earthlings and my

7  
00:00:49,430 --> 00:00:46,440  
fellow crew of the spaceship earth

8  
00:00:51,410 --> 00:00:49,440  
welcome to ask an astrobiologist the

9  
00:00:53,209 --> 00:00:51,420  
show that celebrates the science and the

10  
00:00:55,610 --> 00:00:53,219  
scientists involved in our quest to

11  
00:00:58,729 --> 00:00:55,620  
understand the nature of life I'm your

12  
00:01:00,529 --> 00:00:58,739  
host Dr Graham the cosmo biologist Lao

13  
00:01:03,950 --> 00:01:00,539

and we're brought to you by the NASA

14

00:01:05,990 --> 00:01:03,960

astrobiology program and segnet.org now

15

00:01:08,149 --> 00:01:06,000

you might have noticed in the ramp up

16

00:01:11,030 --> 00:01:08,159

for today's show not only do we have an

17

00:01:13,750 --> 00:01:11,040

all-new season here in 2023 we also have

18

00:01:16,490 --> 00:01:13,760

all new music all new graphics new logos

19

00:01:18,590 --> 00:01:16,500

a huge thanks to the artist Melissa

20

00:01:20,570 --> 00:01:18,600

flower for developing this new set of

21

00:01:22,190 --> 00:01:20,580

logos for us we hope that you're really

22

00:01:24,410 --> 00:01:22,200

excited for the show this year just like

23

00:01:27,649 --> 00:01:24,420

we are we have so much to bring you it's

24

00:01:30,109 --> 00:01:27,659

now over 50 episodes of is episode 54 of

25

00:01:32,630 --> 00:01:30,119

ask an astrobiologist and it has been

26

00:01:34,249 --> 00:01:32,640

quite a ride so with our new change in

27

00:01:35,929 --> 00:01:34,259

logos we thought we'd bring back the

28

00:01:38,149 --> 00:01:35,939

original host from the very first

29

00:01:40,370 --> 00:01:38,159

episode of the show started uh and who

30

00:01:43,069 --> 00:01:40,380

handed off the hosting to me as well

31

00:01:44,810 --> 00:01:43,079

before we introduce that host though I

32

00:01:47,090 --> 00:01:44,820

do want to say a huge thank you to all

33

00:01:48,410 --> 00:01:47,100

of you who are watching now live all of

34

00:01:50,210 --> 00:01:48,420

those who watch the recording later

35

00:01:52,370 --> 00:01:50,220

thank you to all of you for tuning in

36

00:01:54,170 --> 00:01:52,380

for joining in this quest with us and

37

00:01:56,330 --> 00:01:54,180

learning more about the nature of life

38

00:01:59,090 --> 00:01:56,340

with us and learning more about what all

39

00:02:00,649 --> 00:01:59,100

these awesome astrobiologists do we

40

00:02:03,950 --> 00:02:00,659

especially want to give a shout out to

41

00:02:07,069 --> 00:02:03,960

debashree das who is at Deb underscore

42

00:02:08,570 --> 00:02:07,079

Astro nerd on Twitter uh Deb shared

43

00:02:10,790 --> 00:02:08,580

about our show and got some engagement

44

00:02:12,890 --> 00:02:10,800

for it and it's always helpful for us to

45

00:02:14,690 --> 00:02:12,900

have our ambassadors out there in the

46

00:02:16,369 --> 00:02:14,700

world sharing about the show talking

47

00:02:18,589 --> 00:02:16,379

about the show and asking questions for

48

00:02:20,570 --> 00:02:18,599

our guests so like I said today's

49

00:02:23,210 --> 00:02:20,580

episode is going to be pretty incredible

50

00:02:25,490 --> 00:02:23,220

we are bringing back on the OG host of

51  
00:02:27,949 --> 00:02:25,500  
ask an astrobiologist to chat with me

52  
00:02:29,750 --> 00:02:27,959  
about his research his work in science

53  
00:02:31,970 --> 00:02:29,760  
communication his work as a businessman

54  
00:02:34,670 --> 00:02:31,980  
or business person uh and and doing

55  
00:02:36,770 --> 00:02:34,680  
entrepreneurship uh and this is Dr

56  
00:02:39,710 --> 00:02:36,780  
sanjoy Sam who's rejoining me here again

57  
00:02:41,270 --> 00:02:39,720  
for ask an astrobiologist Dr Sam is a

58  
00:02:43,250 --> 00:02:41,280  
scientist an engineer and social

59  
00:02:46,309 --> 00:02:43,260  
entrepreneur who's passionate about

60  
00:02:48,530 --> 00:02:46,319  
space exploration and astrobiology

61  
00:02:50,330 --> 00:02:48,540  
um and so welcome to the show sanjoy

62  
00:02:52,369 --> 00:02:50,340  
thank you so much for joining us

63  
00:02:53,930 --> 00:02:52,379

so great to be background hello to you

64

00:02:55,430 --> 00:02:53,940

hello to the team and hello to all of

65

00:02:57,589 --> 00:02:55,440

you who are watching it's such a

66

00:02:59,809 --> 00:02:57,599

privilege to be back and it's so great

67

00:03:01,490 --> 00:02:59,819

to have you son Joy you're you have such

68

00:03:03,710 --> 00:03:01,500

a huge background from engineering

69

00:03:05,750 --> 00:03:03,720

through science doing geochemistry

70

00:03:07,729 --> 00:03:05,760

studying thermodynamics and there's so

71

00:03:09,470 --> 00:03:07,739

much that you've done I actually want to

72

00:03:11,630 --> 00:03:09,480

start the show though talking about some

73

00:03:13,670 --> 00:03:11,640

of your work as an entrepreneur in

74

00:03:16,550 --> 00:03:13,680

developing Sega net and Blue Marble

75

00:03:18,710 --> 00:03:16,560

space and how you became an entrepreneur

76

00:03:20,750 --> 00:03:18,720

in your career

77

00:03:22,790 --> 00:03:20,760

talk about that it was not something I

78

00:03:24,649 --> 00:03:22,800

really planned to begin with when I was

79

00:03:27,350 --> 00:03:24,659

a grad student I was very active in the

80

00:03:28,869 --> 00:03:27,360

space conference circuit and I give a

81

00:03:30,949 --> 00:03:28,879

presentation at the international

82

00:03:32,930 --> 00:03:30,959

astronautical Congress where I was

83

00:03:34,970 --> 00:03:32,940

advocating that

84

00:03:36,830 --> 00:03:34,980

um astronauts should wear a common

85

00:03:38,270 --> 00:03:36,840

symbol when exploring space so you know

86

00:03:40,130 --> 00:03:38,280

instead of their national flag or in

87

00:03:41,690 --> 00:03:40,140

addition to the national flag we're a

88

00:03:43,309 --> 00:03:41,700

symbol that really represents Humanity

89

00:03:45,410 --> 00:03:43,319

because once they're in space they're

90

00:03:47,330 --> 00:03:45,420

all ambassadors of planet Earth first

91

00:03:48,770 --> 00:03:47,340

and foremost and then of course um

92

00:03:50,270 --> 00:03:48,780

representatives of their home Nations

93

00:03:51,949 --> 00:03:50,280

but first and foremost they're

94

00:03:53,390 --> 00:03:51,959

ambassadors of planet Earth so

95

00:03:55,130 --> 00:03:53,400

surprisingly the talk was really well

96

00:03:56,809 --> 00:03:55,140

received I got some really good feedback

97

00:03:58,729 --> 00:03:56,819

and that the plundery session during

98

00:04:00,229 --> 00:03:58,739

that conference

99

00:04:01,789 --> 00:04:00,239

um there was some important head of

100

00:04:04,190 --> 00:04:01,799

space agencies as giving presentation

101  
00:04:06,649 --> 00:04:04,200  
and during the Q a session somebody

102  
00:04:08,869 --> 00:04:06,659  
asked him what flag should Humanity

103  
00:04:11,149 --> 00:04:08,879  
return to the moon when Humanity does in

104  
00:04:14,330 --> 00:04:11,159  
fact return to the moon and he answered

105  
00:04:16,069 --> 00:04:14,340  
uh all the flags of all the nations so I

106  
00:04:18,770 --> 00:04:16,079  
giant face pound myself because like

107  
00:04:20,509 --> 00:04:18,780  
that seems very impractical so but I

108  
00:04:22,670 --> 00:04:20,519  
still had the flag for my presentation

109  
00:04:24,590 --> 00:04:22,680  
of like the the morning off which is

110  
00:04:27,350 --> 00:04:24,600  
just a picture of a picture of the Earth

111  
00:04:28,730 --> 00:04:27,360  
so I Rose my hand and somebody gave him

112  
00:04:30,170 --> 00:04:28,740  
the microphone and I said well what

113  
00:04:32,270 --> 00:04:30,180

about this flag I kind of showed it to

114

00:04:33,830 --> 00:04:32,280

everybody in the audience and to the to

115

00:04:35,570 --> 00:04:33,840

the speaker and like to my biggest

116

00:04:37,310 --> 00:04:35,580

surprise the entire audience started

117

00:04:38,150 --> 00:04:37,320

clapping like it really resonated with

118

00:04:40,010 --> 00:04:38,160

people

119

00:04:41,749 --> 00:04:40,020

so I went to the stage and gave him the

120

00:04:42,830 --> 00:04:41,759

flag and once I got back home I was

121

00:04:44,030 --> 00:04:42,840

thinking more about this moment because

122

00:04:45,770 --> 00:04:44,040

it's one of those few moments in life

123

00:04:48,290 --> 00:04:45,780

that kind of shake your soul a little

124

00:04:50,990 --> 00:04:48,300

bit and uh I decided to go to this

125

00:04:53,270 --> 00:04:51,000

decided to see how far this idea will go

126  
00:04:55,670 --> 00:04:53,280  
so I started with Rumble space and as an

127  
00:04:57,770 --> 00:04:55,680  
organization as a non-profit um to push

128  
00:05:00,230 --> 00:04:57,780  
this idea so to sell flags and stickers

129  
00:05:03,170 --> 00:05:00,240  
and patches to promote a common symbol

130  
00:05:04,430 --> 00:05:03,180  
of international unity in Exploration I

131  
00:05:06,110 --> 00:05:04,440  
wrote a paper that was published in

132  
00:05:08,390 --> 00:05:06,120  
space policy which is still I think the

133  
00:05:10,550 --> 00:05:08,400  
only paper peer-reviewed paper that has

134  
00:05:12,590 --> 00:05:10,560  
such a symbol as a proposition for

135  
00:05:16,610 --> 00:05:12,600  
Humanity and things kind of took off

136  
00:05:19,670 --> 00:05:16,620  
from there you know in after finishing a

137  
00:05:21,050 --> 00:05:19,680  
PhD and a postdoc I had a drink with my

138  
00:05:22,730 --> 00:05:21,060

close colleague and good friend Jacob

139

00:05:25,070 --> 00:05:22,740

hack misra deciding what do we want to

140

00:05:26,810 --> 00:05:25,080

do with our career and uh we thought

141

00:05:28,909 --> 00:05:26,820

that starting a non-profit that really

142

00:05:30,409 --> 00:05:28,919

focuses on the human aspect of Science

143

00:05:32,090 --> 00:05:30,419

and science communication and getting

144

00:05:33,350 --> 00:05:32,100

people excited about science was

145

00:05:34,850 --> 00:05:33,360

something different that didn't quite

146

00:05:36,469 --> 00:05:34,860

exist yet where you know science

147

00:05:38,150 --> 00:05:36,479

communication is really built into the

148

00:05:41,150 --> 00:05:38,160

fabric of the organization

149

00:05:42,529 --> 00:05:41,160

and uh learned how to you know do

150

00:05:43,969 --> 00:05:42,539

business with the government and then I

151  
00:05:46,370 --> 00:05:43,979  
went to do business school while doing

152  
00:05:47,810 --> 00:05:46,380  
my postdoc evening classes kind of learn

153  
00:05:49,969 --> 00:05:47,820  
the language of business accounting

154  
00:05:51,830 --> 00:05:49,979  
Finance operations all that things and

155  
00:05:53,510 --> 00:05:51,840  
then went for it and here we are you

156  
00:05:55,189 --> 00:05:53,520  
know it's 12 years later and it's still

157  
00:05:56,870 --> 00:05:55,199  
going strong and it's doing things that

158  
00:05:59,330 --> 00:05:56,880  
I could have never imagined

159  
00:06:01,249 --> 00:05:59,340  
no I love it so much and uh for our

160  
00:06:03,050 --> 00:06:01,259  
audience if you don't know uh I I joined

161  
00:06:05,270 --> 00:06:03,060  
Blue Marble space in 2017 after

162  
00:06:06,650 --> 00:06:05,280  
finishing my PhD and became the director

163  
00:06:08,689 --> 00:06:06,660

of communications and marketing for the

164

00:06:11,150 --> 00:06:08,699

organization uh you can learn more about

165

00:06:12,590 --> 00:06:11,160

Blue Marble space at [blumarlespace.org](http://blumarlespace.org)

166

00:06:15,710 --> 00:06:12,600

as well as the Blue Marble space

167

00:06:17,029 --> 00:06:15,720

Institute of science at [bmsis.org](http://bmsis.org)

168

00:06:18,950 --> 00:06:17,039

um and so it's interesting to see you

169

00:06:20,210 --> 00:06:18,960

know this this pivotal moment in your

170

00:06:22,430 --> 00:06:20,220

career and I actually I actually happen

171

00:06:24,950 --> 00:06:22,440

to have my flag patch right here there

172

00:06:26,330 --> 00:06:24,960

you go awesome of our Earth

173

00:06:27,770 --> 00:06:26,340

um in that moment where you shared that

174

00:06:29,150 --> 00:06:27,780

flag was like that that precipitous

175

00:06:30,890 --> 00:06:29,160

moment in your life that kind of

176  
00:06:32,990 --> 00:06:30,900  
impacted you to make this big change and

177  
00:06:34,790 --> 00:06:33,000  
become a social entrepreneur and create

178  
00:06:36,170 --> 00:06:34,800  
an organization that

179  
00:06:37,430 --> 00:06:36,180  
um you know not only the scientists that

180  
00:06:39,650 --> 00:06:37,440  
we've served but also so many young

181  
00:06:41,330 --> 00:06:39,660  
students now from around the world have

182  
00:06:43,430 --> 00:06:41,340  
been part of Blue Marble space through

183  
00:06:44,990 --> 00:06:43,440  
the young scientists program through the

184  
00:06:47,029 --> 00:06:45,000  
visiting Scholars Program through

185  
00:06:49,129 --> 00:06:47,039  
various other opportunities that you've

186  
00:06:51,650 --> 00:06:49,139  
offered I wonder if you can speak for a

187  
00:06:54,350 --> 00:06:51,660  
moment to your vision for how important

188  
00:06:56,870 --> 00:06:54,360

it is to bring in a younger Scholars

189

00:06:58,909 --> 00:06:56,880

younger researchers and and to Mentor

190

00:07:00,110 --> 00:06:58,919

them to become scientists and Engineers

191

00:07:01,550 --> 00:07:00,120

to the Future

192

00:07:03,890 --> 00:07:01,560

I think it's the most important thing we

193

00:07:06,170 --> 00:07:03,900

can do I mean science is a universal

194

00:07:07,610 --> 00:07:06,180

language of our society it doesn't

195

00:07:09,950 --> 00:07:07,620

matter what you believe

196

00:07:11,990 --> 00:07:09,960

what language you speak what the color

197

00:07:13,610 --> 00:07:12,000

of your skin is science brings us

198

00:07:15,590 --> 00:07:13,620

together is a there's one way of

199

00:07:18,050 --> 00:07:15,600

understanding the world that provides

200

00:07:20,870 --> 00:07:18,060

progress to to society

201  
00:07:22,730 --> 00:07:20,880  
um and you know it's bringing these

202  
00:07:24,529 --> 00:07:22,740  
these kids together from all over the

203  
00:07:26,210 --> 00:07:24,539  
world to work together for a summer at

204  
00:07:28,189 --> 00:07:26,220  
least in our young scientist program and

205  
00:07:30,710 --> 00:07:28,199  
bathe them in the spirit that by working

206  
00:07:32,990 --> 00:07:30,720  
together on common problems the

207  
00:07:35,330 --> 00:07:33,000  
diversity of your opinions into how that

208  
00:07:36,830 --> 00:07:35,340  
problem should be solved enhance the

209  
00:07:38,930 --> 00:07:36,840  
quality of the work and the potential

210  
00:07:40,730 --> 00:07:38,940  
solution to address this problem so I

211  
00:07:42,230 --> 00:07:40,740  
think like getting more and more people

212  
00:07:44,629 --> 00:07:42,240  
from all over the world to do scientific

213  
00:07:46,189 --> 00:07:44,639

research is kind of bring Humanity

214

00:07:47,330 --> 00:07:46,199

together and by goodness do we need that

215

00:07:49,730 --> 00:07:47,340

these days

216

00:07:51,529 --> 00:07:49,740

absolutely and I didn't mention in your

217

00:07:53,629 --> 00:07:51,539

introduction your background you started

218

00:07:55,010 --> 00:07:53,639

off in engineering you started off

219

00:07:56,749 --> 00:07:55,020

studying aerospace engineering you

220

00:07:58,969 --> 00:07:56,759

earned your Bachelor's in 2002 from fit

221

00:08:01,129 --> 00:07:58,979

in 2004 you earned a master's from

222

00:08:02,689 --> 00:08:01,139

University of Washington uh also in the

223

00:08:04,730 --> 00:08:02,699

realm of Aeronautics and astronautics

224

00:08:06,830 --> 00:08:04,740

and then you made the switch over to

225

00:08:09,650 --> 00:08:06,840

doing geological Sciences planetary

226

00:08:11,570 --> 00:08:09,660

sciences and astrobiology for your PhD

227

00:08:13,309 --> 00:08:11,580

at the University of Washington I'm

228

00:08:15,290 --> 00:08:13,319

wondering you know what what intrigued

229

00:08:18,050 --> 00:08:15,300

you in making that switch from from

230

00:08:19,850 --> 00:08:18,060

aerospace engineering uh moving over to

231

00:08:21,710 --> 00:08:19,860

the Sciences for your PhD

232

00:08:22,850 --> 00:08:21,720

it's again one of these moments that

233

00:08:25,490 --> 00:08:22,860

happened in your life that you didn't

234

00:08:28,990 --> 00:08:25,500

quite expect so I was very happy as an

235

00:08:32,570 --> 00:08:29,000

aerospace engineer I was doing a

236

00:08:34,250 --> 00:08:32,580

focus in in fluid mechanics that is the

237

00:08:35,870 --> 00:08:34,260

physics of air and water and the

238

00:08:37,730 --> 00:08:35,880

department required taking classes

239

00:08:40,250 --> 00:08:37,740

outside of the department but in the

240

00:08:41,870 --> 00:08:40,260

same general realm so University of

241

00:08:44,570 --> 00:08:41,880

Washington has a fantastic atmospheric

242

00:08:46,850 --> 00:08:44,580

sciences department so I looked I signed

243

00:08:49,070 --> 00:08:46,860

up for a class in planetary atmospheres

244

00:08:51,170 --> 00:08:49,080

and the professor for that class uh

245

00:08:53,150 --> 00:08:51,180

Professor David catling is an

246

00:08:54,650 --> 00:08:53,160

astrobiologist and I had never heard the

247

00:08:56,509 --> 00:08:54,660

term Master biology right I discovered

248

00:08:57,590 --> 00:08:56,519

it quite late in my academic career I

249

00:08:59,090 --> 00:08:57,600

was like halfway through a masters

250

00:09:01,550 --> 00:08:59,100

before I learned what astrophology was

251

00:09:03,470 --> 00:09:01,560

and so he thought that class was that

252

00:09:05,630 --> 00:09:03,480

spirit and that completely blew my mind

253

00:09:07,190 --> 00:09:05,640

and I remember like spending all my time

254

00:09:09,829 --> 00:09:07,200

working on the paper for that class

255

00:09:12,170 --> 00:09:09,839

which was on the topic of water on Mars

256

00:09:13,790 --> 00:09:12,180

and kind of neglecting my not neglecting

257

00:09:15,829 --> 00:09:13,800

but not spending as much effort on the

258

00:09:17,990 --> 00:09:15,839

engineering classes and that got my head

259

00:09:19,310 --> 00:09:18,000

turning it's like oh my gosh like this

260

00:09:21,170 --> 00:09:19,320

is like what should I do what should I

261

00:09:23,090 --> 00:09:21,180

do kind of had quarter life crisis I

262

00:09:25,070 --> 00:09:23,100

guess I could say and then I made the

263

00:09:27,650 --> 00:09:25,080

decisions like okay ultimately you want

264

00:09:29,509 --> 00:09:27,660

to be excited about what you study and

265

00:09:31,850 --> 00:09:29,519

um and this new field of astrobiology

266

00:09:34,970 --> 00:09:31,860

because it's so much philosophical as

267

00:09:37,430 --> 00:09:34,980

well as rigorous really attracted me and

268

00:09:39,949 --> 00:09:37,440

so I decided to finish the Masters and

269

00:09:41,630 --> 00:09:39,959

start a PhD in a discipline I knew

270

00:09:43,910 --> 00:09:41,640

nothing of I didn't know anything about

271

00:09:46,730 --> 00:09:43,920

geology or geophysics or astrobiology

272

00:09:48,350 --> 00:09:46,740

but I had incredible support from my

273

00:09:50,810 --> 00:09:48,360

mentors at the University there who

274

00:09:52,070 --> 00:09:50,820

believed in me and they didn't have to I

275

00:09:54,769 --> 00:09:52,080

was really a liability when I first

276

00:09:57,230 --> 00:09:54,779

started but they believed in me and I'm

277

00:09:59,630 --> 00:09:57,240

still grateful very much to this day and

278

00:10:02,030 --> 00:09:59,640

you know loaded myself as classes I was

279

00:10:04,370 --> 00:10:02,040

finishing my my masters while at the

280

00:10:06,350 --> 00:10:04,380

same time starting the PHD loaded myself

281

00:10:08,389 --> 00:10:06,360

with classes for like for like two or

282

00:10:10,190 --> 00:10:08,399

three years I was taking introduction to

283

00:10:11,630 --> 00:10:10,200

geology you know as a freshman you know

284

00:10:14,150 --> 00:10:11,640

just like really loading myself with

285

00:10:15,290 --> 00:10:14,160

classes and I just loved every single

286

00:10:17,210 --> 00:10:15,300

one of them it was just so interesting

287

00:10:19,490 --> 00:10:17,220

so that that made me realize I made the

288

00:10:21,230 --> 00:10:19,500

right choice and I just went from there

289

00:10:23,990 --> 00:10:21,240

you know I still managed to finish in

290

00:10:25,970 --> 00:10:24,000

six years or that was a lot of work but

291

00:10:27,590 --> 00:10:25,980

um you know I don't regret it since I

292

00:10:30,829 --> 00:10:27,600

think the background in engineering and

293

00:10:32,449 --> 00:10:30,839

the PHD in science gives me a niche in

294

00:10:34,370 --> 00:10:32,459

how I approach problems that's perhaps

295

00:10:36,170 --> 00:10:34,380

different than a lot of scientists and

296

00:10:38,750 --> 00:10:36,180

yeah it's been working out well for me

297

00:10:40,190 --> 00:10:38,760

so far yeah I love it I can definitely

298

00:10:42,350 --> 00:10:40,200

sympathize too when I first started my

299

00:10:44,329 --> 00:10:42,360

PhD in geology I only had three

300

00:10:46,370 --> 00:10:44,339

undergrad courses in the earth Sciences

301

00:10:48,530 --> 00:10:46,380

at that point and so it was a slog it

302

00:10:49,910 --> 00:10:48,540

was it was a lot to catch up but um you

303

00:10:51,410 --> 00:10:49,920

know but for everyone out there you can

304

00:10:53,329 --> 00:10:51,420

make a change in your career you're

305

00:10:55,370 --> 00:10:53,339

never stuck in One path or One Direction

306

00:10:57,590 --> 00:10:55,380

uh it's always up to you where you

307

00:10:59,030 --> 00:10:57,600

choose to meander in your careers uh

308

00:11:01,130 --> 00:10:59,040

sanjoy I do want to talk a little bit

309

00:11:02,930 --> 00:11:01,140

about your research here while we have

310

00:11:04,730 --> 00:11:02,940

some time before talking a bit about the

311

00:11:06,170 --> 00:11:04,740

ask an astrobiologist show and its

312

00:11:07,670 --> 00:11:06,180

history and a bit more about you

313

00:11:09,110 --> 00:11:07,680

personally

314

00:11:10,250 --> 00:11:09,120

um and leading up to the show you and I

315

00:11:11,329 --> 00:11:10,260

were discussing your research and you

316

00:11:13,310 --> 00:11:11,339

said something that I really want to

317

00:11:15,170 --> 00:11:13,320

draw out here a little bit you mentioned

318

00:11:17,509 --> 00:11:15,180

that part of your work is quantifying

319

00:11:19,190 --> 00:11:17,519

the concept of habitability and I really

320

00:11:21,410 --> 00:11:19,200

wanna I wanna hear you in your words

321

00:11:24,170 --> 00:11:21,420

explain what that means to our audience

322

00:11:25,850 --> 00:11:24,180

and the research that you do sure yeah

323

00:11:27,650 --> 00:11:25,860

happy too um it's funny because my

324

00:11:28,790 --> 00:11:27,660

postdoc had nothing to do with my PhD I

325

00:11:30,470 --> 00:11:28,800

kind of like doing these things I was

326

00:11:32,329 --> 00:11:30,480

like oh I find a new something shiny and

327

00:11:33,350 --> 00:11:32,339

and you know the tools of science teach

328

00:11:34,430 --> 00:11:33,360

you how to solve a problem doesn't

329

00:11:36,769 --> 00:11:34,440

really matter what the problem is

330

00:11:38,329 --> 00:11:36,779

knowledge you can acquire and then solve

331

00:11:40,550 --> 00:11:38,339

the problems as it comes along

332

00:11:43,970 --> 00:11:40,560

quantifying the concept of habitability

333

00:11:46,790 --> 00:11:43,980

means that you essentially treat life

334

00:11:48,350 --> 00:11:46,800

like a light bulb so in order for a

335

00:11:50,750 --> 00:11:48,360

light bulb to shine you need to

336

00:11:53,269 --> 00:11:50,760

understand the electrical circuit that's

337

00:11:55,790 --> 00:11:53,279

providing energy to the bulb in the same

338

00:11:58,310 --> 00:11:55,800

way the environment provides energy to

339

00:12:01,069 --> 00:11:58,320

biology so I do the same coupling

340

00:12:03,590 --> 00:12:01,079

voltage and current uh from the natural

341

00:12:06,650 --> 00:12:03,600

environment delivered to biological

342

00:12:10,069 --> 00:12:06,660

systems so you can calculate

343

00:12:13,069 --> 00:12:10,079

um given what is dissolved in water what

344

00:12:14,750 --> 00:12:13,079

the voltage is for biology and it's

345

00:12:17,269 --> 00:12:14,760

important to talk about what's dissolved

346

00:12:19,970 --> 00:12:17,279

in water because Water by itself is kind

347

00:12:21,590 --> 00:12:19,980

of not habitable it's really the the

348

00:12:23,690 --> 00:12:21,600

energy that's provided by the stuff

349

00:12:26,210 --> 00:12:23,700

that's dissolved in water that biology

350

00:12:29,509 --> 00:12:26,220

can take advantage of and that gives you

351

00:12:31,670 --> 00:12:29,519

the voltage in terms of the current you

352

00:12:34,430 --> 00:12:31,680

have to think about how that material

353

00:12:36,829 --> 00:12:34,440

gets delivered inside a biological cell

354

00:12:38,449 --> 00:12:36,839

so in order to be quantitative about it

355

00:12:41,449 --> 00:12:38,459

I'm trying to think of the simplest cell

356

00:12:44,269 --> 00:12:41,459

possible that delivers that rather

357

00:12:46,790 --> 00:12:44,279

uptakes into the cell from the outside

358

00:12:47,930 --> 00:12:46,800

via simple diffusion processes but

359

00:12:50,509 --> 00:12:47,940

that's the most simple way to think

360

00:12:52,430 --> 00:12:50,519

about it because many biological cells

361

00:12:54,050 --> 00:12:52,440

you know have active Transporters in

362

00:12:55,850 --> 00:12:54,060

their cell membrane and that complicates

363

00:12:57,530 --> 00:12:55,860

the mathematics tremendously however

364

00:12:59,509 --> 00:12:57,540

diffusion you know we can also solve a

365

00:13:01,730 --> 00:12:59,519

diffusion equation it's it's it's a Well

366

00:13:04,190 --> 00:13:01,740

understood equation that can be

367

00:13:06,470 --> 00:13:04,200

tractable computationally so you you

368

00:13:08,509 --> 00:13:06,480

simulate the diffusion of stuff into the

369

00:13:10,850 --> 00:13:08,519

cell so in particular I'm interested in

370

00:13:13,129 --> 00:13:10,860

hydrogen and CO<sub>2</sub> which are two very

371

00:13:15,110 --> 00:13:13,139

simple molecules that are neutral so

372

00:13:16,610 --> 00:13:15,120

they defeat they basically don't see the

373

00:13:19,009 --> 00:13:16,620

the cell membrane just diffuse right

374

00:13:21,590 --> 00:13:19,019

through which simplifies the math

375

00:13:24,410 --> 00:13:21,600

and um and and yeah so you have to also

376

00:13:27,410 --> 00:13:24,420

think about well at what rate do they

377

00:13:29,569 --> 00:13:27,420

use do they uh you know uh do the

378

00:13:33,710 --> 00:13:29,579

enzymes process the carbon or the

379

00:13:35,870 --> 00:13:33,720

hydrogen and the rates are you know it's

380

00:13:37,430 --> 00:13:35,880

a lot of studies on Earth that that have

381

00:13:39,889 --> 00:13:37,440

assessed what those rates are but

382

00:13:41,690 --> 00:13:39,899

thinking about astrobiology that might

383

00:13:43,250 --> 00:13:41,700

not necessarily operate with the same

384

00:13:44,870 --> 00:13:43,260

rate to kind of look at different kinds

385

00:13:47,150 --> 00:13:44,880

of rates the kinds of cell size because

386

00:13:49,129 --> 00:13:47,160

that's that affects the input of stuff

387

00:13:50,449 --> 00:13:49,139

in the in the cell as well and so you

388

00:13:53,030 --> 00:13:50,459

can make these quantitative links

389

00:13:54,949 --> 00:13:53,040

between between how to deliver these

390

00:13:56,329 --> 00:13:54,959

stuff that's dissolved in the water and

391

00:13:58,970 --> 00:13:56,339

had that stuff that dissolved and water

392

00:14:00,230 --> 00:13:58,980

gets absorbed by the by the cell so then

393

00:14:03,290 --> 00:14:00,240

you can say oh yeah there's this much

394

00:14:06,230 --> 00:14:03,300

energy in in the in the in the system

395

00:14:08,329 --> 00:14:06,240

you can expect a doubling time based on

396

00:14:10,370 --> 00:14:08,339

that energy for the cells of this much

397

00:14:12,530 --> 00:14:10,380

and eventually I would like to get from

398

00:14:14,990 --> 00:14:12,540

go from the energy of the environment to

399

00:14:16,730 --> 00:14:15,000

the potential biomass that it can hold

400

00:14:18,829 --> 00:14:16,740

working towards that but right now

401  
00:14:20,750 --> 00:14:18,839  
really focusing on the the electrical

402  
00:14:22,009 --> 00:14:20,760  
analogy of the the environment for

403  
00:14:24,110 --> 00:14:22,019  
biology

404  
00:14:26,150 --> 00:14:24,120  
awesome and so and you've done you know

405  
00:14:27,410 --> 00:14:26,160  
work on on systems here on Earth looking

406  
00:14:29,329 --> 00:14:27,420  
at this and these you know

407  
00:14:31,370 --> 00:14:29,339  
serpentinizing systems where water and

408  
00:14:32,629 --> 00:14:31,380  
rock are reacting together

409  
00:14:34,910 --> 00:14:32,639  
um but you've also then considered how

410  
00:14:37,069 --> 00:14:34,920  
this might apply to Ocean worlds as well

411  
00:14:39,470 --> 00:14:37,079  
to these oceans in places like Europa

412  
00:14:41,449 --> 00:14:39,480  
and Enceladus and these other worlds

413  
00:14:42,829 --> 00:14:41,459

um I do know one thing about you and it

414

00:14:44,870 --> 00:14:42,839

said something that all of the grad

415

00:14:47,750 --> 00:14:44,880

students at UW and astrobiology get to

416

00:14:49,610 --> 00:14:47,760

do is to go on a submersible and to to

417

00:14:50,870 --> 00:14:49,620

learn about ocean science

418

00:14:52,910 --> 00:14:50,880

um I wonder if you can talk about that

419

00:14:55,610 --> 00:14:52,920

for us and what that experience is like

420

00:14:57,050 --> 00:14:55,620

yeah happy to um it was definitely not

421

00:14:58,610 --> 00:14:57,060

something that all grass students got to

422

00:14:59,870 --> 00:14:58,620

do I was very lucky

423

00:15:03,110 --> 00:14:59,880

um part of the astrobiology program

424

00:15:05,090 --> 00:15:03,120

there uh we have to do a rotation in

425

00:15:06,350 --> 00:15:05,100

Labs that have nothing to do with our

426

00:15:08,230 --> 00:15:06,360

our work

427

00:15:11,269 --> 00:15:08,240

so I volunteered in a

428

00:15:13,850 --> 00:15:11,279

thermophile lab so it was a lab of Dr

429

00:15:17,269 --> 00:15:13,860

John Barris who was studying

430

00:15:18,530 --> 00:15:17,279

um how life thrives in hot and warm and

431

00:15:20,990 --> 00:15:18,540

hot environments

432

00:15:22,490 --> 00:15:21,000

and so um amazingly

433

00:15:23,269 --> 00:15:22,500

um there was an opportunity to go on a

434

00:15:25,670 --> 00:15:23,279

cruise

435

00:15:29,269 --> 00:15:25,680

which is a vessel that goes to a site of

436

00:15:31,850 --> 00:15:29,279

hydrothermal activity and the vessel had

437

00:15:33,470 --> 00:15:31,860

on that first time I went had not Alvin

438

00:15:35,629 --> 00:15:33,480

the submersible but Jason which is the

439

00:15:37,189 --> 00:15:35,639

ROV the robot

440

00:15:38,750 --> 00:15:37,199

and that was already incredible you know

441

00:15:40,730 --> 00:15:38,760

in a control room and you can see the

442

00:15:42,170 --> 00:15:40,740

pilots operating this robot live on the

443

00:15:43,910 --> 00:15:42,180

sea floor and you can see these

444

00:15:45,710 --> 00:15:43,920

incredible vents coming out and they're

445

00:15:48,050 --> 00:15:45,720

sampling and everything and when that

446

00:15:50,870 --> 00:15:48,060

vessel came out or the when Jason came

447

00:15:53,449 --> 00:15:50,880

back on Deck I had to rush to the boats

448

00:15:55,009 --> 00:15:53,459

and grab the samples and inject

449

00:15:57,110 --> 00:15:55,019

everything in my test tubes that were

450

00:15:59,689 --> 00:15:57,120

previously prepared to see what actually

451  
00:16:02,210 --> 00:15:59,699  
grew and uh had a great experience there

452  
00:16:04,189 --> 00:16:02,220  
I was invited back the following year on

453  
00:16:07,189 --> 00:16:04,199  
another Cruise which had Alba in the

454  
00:16:08,930 --> 00:16:07,199  
summer summer school and I was talking

455  
00:16:10,970 --> 00:16:08,940  
with the pi saying you know I do a lot

456  
00:16:13,430 --> 00:16:10,980  
of communication science communication

457  
00:16:15,350 --> 00:16:13,440  
and I have a one of my message is that

458  
00:16:17,090 --> 00:16:15,360  
it's it's really powerful to go into

459  
00:16:19,670 --> 00:16:17,100  
space because of this concept called the

460  
00:16:21,290 --> 00:16:19,680  
overview effects and that kind of the

461  
00:16:23,030 --> 00:16:21,300  
realization that we're all kind of

462  
00:16:25,310 --> 00:16:23,040  
living on this tiny small blue marble

463  
00:16:27,230 --> 00:16:25,320

together and we better cooperate if we

464

00:16:28,610 --> 00:16:27,240

already want to get anywhere but I

465

00:16:30,949 --> 00:16:28,620

didn't know how to express what it was

466

00:16:32,509 --> 00:16:30,959

like to be in space

467

00:16:34,370 --> 00:16:32,519

um so the closest city can be is

468

00:16:35,750 --> 00:16:34,380

actually in a submersible sitting on the

469

00:16:37,730 --> 00:16:35,760

ocean floor because there's like a

470

00:16:40,670 --> 00:16:37,740

window this thick that separates you

471

00:16:41,749 --> 00:16:40,680

from certain death and

472

00:16:44,870 --> 00:16:41,759

um I was of course on the scientific

473

00:16:47,810 --> 00:16:44,880

crew of the boat and so he kicks the pi

474

00:16:50,810 --> 00:16:47,820

um Jim Holden at UMass Amherst allowed

475

00:16:52,610 --> 00:16:50,820

me to be part of the crew on one dive on

476

00:16:54,050 --> 00:16:52,620

Alvin and so we spent eight hours on the

477

00:16:56,629 --> 00:16:54,060

sea floor great day to spend the day in

478

00:16:58,610 --> 00:16:56,639

the office and uh you know work to

479

00:16:59,930 --> 00:16:58,620

sample the different Vents and have to

480

00:17:01,910 --> 00:16:59,940

say like seeing an event in three

481

00:17:04,429 --> 00:17:01,920

dimensions with your own eyes as opposed

482

00:17:07,010 --> 00:17:04,439

to kind of 2D on a on that screen is is

483

00:17:09,650 --> 00:17:07,020

a whole new emotional experience the

484

00:17:11,569 --> 00:17:09,660

power that you feel of the of mother

485

00:17:12,710 --> 00:17:11,579

earth when you're down there similarly

486

00:17:14,870 --> 00:17:12,720

when you

487

00:17:15,890 --> 00:17:14,880

um I did some work in on Mount Etna

488

00:17:17,210 --> 00:17:15,900

where I was sitting on the creature of

489

00:17:20,030 --> 00:17:17,220

the volcano and the whole thing shakes

490

00:17:22,130 --> 00:17:20,040

like you also have this oh I respect so

491

00:17:24,650 --> 00:17:22,140

it was just really really powerful and

492

00:17:26,329 --> 00:17:24,660

so um yeah so you know spend eight hours

493

00:17:28,370 --> 00:17:26,339

on the sea floor collecting samples the

494

00:17:30,409 --> 00:17:28,380

way that crabs were waving back

495

00:17:32,090 --> 00:17:30,419

um just a really really incredible

496

00:17:33,950 --> 00:17:32,100

experience that I enjoy sharing about

497

00:17:35,630 --> 00:17:33,960

when I give out witch talks

498

00:17:36,770 --> 00:17:35,640

that's awesome

499

00:17:38,510 --> 00:17:36,780

um and there's so much to impact there

500

00:17:40,010 --> 00:17:38,520

that we can talk about I do want to come

501  
00:17:42,590 --> 00:17:40,020  
back around to this idea of like the

502  
00:17:44,510 --> 00:17:42,600  
impact of of the person who's exploring

503  
00:17:46,070 --> 00:17:44,520  
and in the environment and learning

504  
00:17:47,570 --> 00:17:46,080  
about these things but I want to come

505  
00:17:48,770 --> 00:17:47,580  
back to this idea of ocean worlds too

506  
00:17:50,750 --> 00:17:48,780  
you know like going down on the ocean

507  
00:17:52,370 --> 00:17:50,760  
floor we're learning about Earth's ocean

508  
00:17:55,010 --> 00:17:52,380  
but we're also learning about possible

509  
00:17:56,810 --> 00:17:55,020  
other oceans out there as well uh

510  
00:17:59,810 --> 00:17:56,820  
through the NASA astrobiology Twitter

511  
00:18:02,270 --> 00:17:59,820  
account which is at Nasa astrobio we

512  
00:18:04,610 --> 00:18:02,280  
asked our audience uh where they think

513  
00:18:06,950 --> 00:18:04,620

NASA should focus our search for life

514

00:18:09,110 --> 00:18:06,960

and watery worlds next we gave the

515

00:18:11,210 --> 00:18:09,120

options of Europa Enceladus Titan or

516

00:18:14,029 --> 00:18:11,220

Triton of course people can always offer

517

00:18:16,310 --> 00:18:14,039

their own suggestions as well but of the

518

00:18:19,310 --> 00:18:16,320

respondents almost 50 percent a little

519

00:18:20,870 --> 00:18:19,320

over 45 percent said Europa is where we

520

00:18:22,789 --> 00:18:20,880

should Target life

521

00:18:24,850 --> 00:18:22,799

um do you think it's possible for a

522

00:18:27,590 --> 00:18:24,860

biosphere to exist in the Europa ocean

523

00:18:28,909 --> 00:18:27,600

uh and and if so uh can you envision

524

00:18:31,010 --> 00:18:28,919

what that might look like down there

525

00:18:31,909 --> 00:18:31,020

yeah I think it would be foolish not to

526

00:18:33,710 --> 00:18:31,919

think so

527

00:18:35,930 --> 00:18:33,720

um because our our understanding of life

528

00:18:37,250 --> 00:18:35,940

is very terrestrial based and if we

529

00:18:38,810 --> 00:18:37,260

think we're going to find earth type

530

00:18:40,490 --> 00:18:38,820

life elsewhere

531

00:18:42,110 --> 00:18:40,500

um that's good that's just hampers your

532

00:18:45,110 --> 00:18:42,120

imagination so

533

00:18:46,909 --> 00:18:45,120

chemistry is incredible the the energy

534

00:18:49,310 --> 00:18:46,919

that's released by water reacting with

535

00:18:51,409 --> 00:18:49,320

rock is is incredible that's certainly

536

00:18:53,930 --> 00:18:51,419

not limited to Earth so there is

537

00:18:57,350 --> 00:18:53,940

certainly energy on the sea floor uh of

538

00:18:59,630 --> 00:18:57,360

Europe and Enceladus and and there was

539

00:19:01,610 --> 00:18:59,640

that kind of energy on surface of Mars

540

00:19:04,130 --> 00:19:01,620

as well and so there's a lot of

541

00:19:06,650 --> 00:19:04,140

possibilities for life to have somehow

542

00:19:09,289 --> 00:19:06,660

uh developed whether it's flourished

543

00:19:10,669 --> 00:19:09,299

that I have no idea but at least develop

544

00:19:12,950 --> 00:19:10,679

like on Earth it seems like life

545

00:19:15,830 --> 00:19:12,960

developed really quickly when Earth and

546

00:19:17,750 --> 00:19:15,840

Mars were very similar and um you know

547

00:19:20,390 --> 00:19:17,760

one of the theories for the origin of

548

00:19:21,830 --> 00:19:20,400

life on Earth is in in Hot Springs and

549

00:19:23,990 --> 00:19:21,840

sorry not in Hot Springs and

550

00:19:26,270 --> 00:19:24,000

hydrothermal vents and so it's plausible

551  
00:19:28,370 --> 00:19:26,280  
to think that such activity exists on

552  
00:19:31,490 --> 00:19:28,380  
Europe and Enceladus and therefore this

553  
00:19:34,730 --> 00:19:31,500  
the environment that could be necessary

554  
00:19:37,070 --> 00:19:34,740  
to start those the basic chemistry uh is

555  
00:19:38,990 --> 00:19:37,080  
is prevalence in our solar system now

556  
00:19:40,610 --> 00:19:39,000  
the million dollar question is how do

557  
00:19:43,430 --> 00:19:40,620  
you go from like basic geochemical

558  
00:19:45,350 --> 00:19:43,440  
reactions to a chemical system capable

559  
00:19:47,870 --> 00:19:45,360  
of darwinian evolution that's like I

560  
00:19:50,330 --> 00:19:47,880  
have no idea but I think you need an

561  
00:19:52,490 --> 00:19:50,340  
environment that provides energy that

562  
00:19:56,510 --> 00:19:52,500  
provides perhaps different types of of

563  
00:19:58,250 --> 00:19:56,520

settings and and so my my personal bet

564

00:20:00,650 --> 00:19:58,260

is I think we have better chance of

565

00:20:02,990 --> 00:20:00,660

finding life on on like in ancient

566

00:20:05,029 --> 00:20:03,000

sediments on Mars than we do on on

567

00:20:07,070 --> 00:20:05,039

Enceladus just because getting through

568

00:20:08,930 --> 00:20:07,080

that ice is going to be just a tedious

569

00:20:10,190 --> 00:20:08,940

work we'll get there eventually but not

570

00:20:11,390 --> 00:20:10,200

tomorrow

571

00:20:13,730 --> 00:20:11,400

um and so

572

00:20:16,310 --> 00:20:13,740

um yeah I think we have all the tools we

573

00:20:17,930 --> 00:20:16,320

need to make that discovery on on in our

574

00:20:19,250 --> 00:20:17,940

own solar system and I agree I think

575

00:20:22,250 --> 00:20:19,260

Europe that would be a fantastic place

576

00:20:25,070 --> 00:20:22,260

to to look for it let's not bias

577

00:20:27,289 --> 00:20:25,080

ourselves by what we know on Earth

578

00:20:29,150 --> 00:20:27,299

let's be creative let's not go into

579

00:20:30,590 --> 00:20:29,160

sci-fi we have to do science which is

580

00:20:32,029 --> 00:20:30,600

rigorous based on what we know but

581

00:20:35,150 --> 00:20:32,039

nonetheless let's really stretch our

582

00:20:36,830 --> 00:20:35,160

mind to think about what uh life could

583

00:20:38,150 --> 00:20:36,840

look like in those worlds

584

00:20:40,250 --> 00:20:38,160

yeah I love it you know without

585

00:20:42,470 --> 00:20:40,260

imagination science takes us nowhere we

586

00:20:43,789 --> 00:20:42,480

need to be able to dream and think

587

00:20:46,190 --> 00:20:43,799

um but also apply the rigorous

588

00:20:47,570 --> 00:20:46,200

techniques and tools of science

589

00:20:49,130 --> 00:20:47,580

um you know and there's so much you said

590

00:20:51,230 --> 00:20:49,140

there that I could talk about for hours

591

00:20:52,370 --> 00:20:51,240

with you and I have in the past um it's

592

00:20:53,450 --> 00:20:52,380

part of why we've been friends for so

593

00:20:54,950 --> 00:20:53,460

long now

594

00:20:56,930 --> 00:20:54,960

um I do want to talk about the show and

595

00:20:58,310 --> 00:20:56,940

it's history and you actually gave me a

596

00:21:01,190 --> 00:20:58,320

good little impetus there as well you

597

00:21:03,169 --> 00:21:01,200

you at first set it a set of these hot

598

00:21:05,330 --> 00:21:03,179

springs and then corrected yourself to

599

00:21:06,710 --> 00:21:05,340

hydrothermal vents but indeed there are

600

00:21:08,690 --> 00:21:06,720

some people who think that maybe life

601  
00:21:11,330 --> 00:21:08,700  
started on the land around Hot Springs

602  
00:21:13,370 --> 00:21:11,340  
instead of in hydrothermal vents or you

603  
00:21:16,130 --> 00:21:13,380  
know that life was brought to Earth uh

604  
00:21:18,110 --> 00:21:16,140  
from rocks from Mars or from Venus

605  
00:21:21,470 --> 00:21:18,120  
um there's a lot we don't know about

606  
00:21:23,510 --> 00:21:21,480  
what life is how life functions

607  
00:21:25,730 --> 00:21:23,520  
um especially beyond Earth if life is

608  
00:21:27,590 --> 00:21:25,740  
out there and so for me part of the

609  
00:21:29,750 --> 00:21:27,600  
beauty of a show like ask an

610  
00:21:32,930 --> 00:21:29,760  
astrobiologist is that it brings

611  
00:21:35,510 --> 00:21:32,940  
together so many of us who are studying

612  
00:21:37,669 --> 00:21:35,520  
this realm that this this realm of life

613  
00:21:40,490 --> 00:21:37,679

from so many different different angles

614

00:21:42,830 --> 00:21:40,500

from geochemistry and and oceanographic

615

00:21:44,870 --> 00:21:42,840

science atmospheric science engineering

616

00:21:46,490 --> 00:21:44,880

those who are applying the humanities

617

00:21:48,710 --> 00:21:46,500

trying to understand the spiritual

618

00:21:50,690 --> 00:21:48,720

aspect of our pursuit to understand the

619

00:21:53,930 --> 00:21:50,700

nature of life you know this is now

620

00:21:56,029 --> 00:21:53,940

episode 54 of ask an astrobiologist and

621

00:21:58,310 --> 00:21:56,039

so first I'd love for you as the

622

00:22:01,610 --> 00:21:58,320

original host to give a little history

623

00:22:03,409 --> 00:22:01,620

of the show to our audience uh and then

624

00:22:05,270 --> 00:22:03,419

I'd love to hear your vision of what

625

00:22:06,890 --> 00:22:05,280

this show has done and of your own time

626

00:22:09,230 --> 00:22:06,900

as a host as well

627

00:22:10,549 --> 00:22:09,240

yeah so the show started um as a

628

00:22:12,529 --> 00:22:10,559

discussion between grass students about

629

00:22:14,630 --> 00:22:12,539

wanting to be more involved in science

630

00:22:17,149 --> 00:22:14,640

communication and sharing the excitement

631

00:22:18,950 --> 00:22:17,159

that astrobiology is and so through

632

00:22:21,350 --> 00:22:18,960

mobile space we launched this initiative

633

00:22:24,529 --> 00:22:21,360

called Sega net which was originally a

634

00:22:27,289 --> 00:22:24,539

platform it was back when when social

635

00:22:28,909 --> 00:22:27,299

media was cool like Facebook was just

636

00:22:30,289 --> 00:22:28,919

starting all this stuff and so it was

637

00:22:32,149 --> 00:22:30,299

always also its own social media

638

00:22:34,010 --> 00:22:32,159

platform where people could engage

639

00:22:36,590 --> 00:22:34,020

um and to create the show to create like

640

00:22:38,330 --> 00:22:36,600

a community of enthusiasts around

641

00:22:39,950 --> 00:22:38,340

astrobiology so not necessarily just

642

00:22:42,409 --> 00:22:39,960

scientist anybody who's excited about it

643

00:22:44,210 --> 00:22:42,419

and we tried different things to get

644

00:22:45,289 --> 00:22:44,220

people excited about the show we had a

645

00:22:46,850 --> 00:22:45,299

mentoring program which is really

646

00:22:48,409 --> 00:22:46,860

valuable that kind of translated into

647

00:22:51,169 --> 00:22:48,419

the young scientist program at rural

648

00:22:53,149 --> 00:22:51,179

space and Sega net started with um sorry

649

00:22:54,649 --> 00:22:53,159

not saying that yeah asking

650

00:22:56,930 --> 00:22:54,659

astrobiologist originally was called

651  
00:22:59,690 --> 00:22:56,940  
Talk to an astrobiologist and we had no

652  
00:23:02,149 --> 00:22:59,700  
budget and so the way it was done is it

653  
00:23:03,850 --> 00:23:02,159  
was just a one-way stream between the

654  
00:23:07,310 --> 00:23:03,860  
person who was interviewed

655  
00:23:09,770 --> 00:23:07,320  
on the second platform and the people

656  
00:23:11,870 --> 00:23:09,780  
including the host would engage with the

657  
00:23:13,850 --> 00:23:11,880  
with the person via chat so the person

658  
00:23:16,490 --> 00:23:13,860  
was talking and reading the questions

659  
00:23:17,930 --> 00:23:16,500  
via chat so it was it was it was it was

660  
00:23:20,870 --> 00:23:17,940  
clunky but it works like we did many

661  
00:23:23,710 --> 00:23:20,880  
many episodes like that and then

662  
00:23:26,690 --> 00:23:23,720  
um in in 2012 2013 something like that

663  
00:23:30,409 --> 00:23:26,700

NASA approached us in wanting to support

664

00:23:32,029 --> 00:23:30,419

uh the activity uh with with a bit of

665

00:23:34,610 --> 00:23:32,039

funding with a bit of production help

666

00:23:37,190 --> 00:23:34,620

Mike toyan our incredible producer who's

667

00:23:39,470 --> 00:23:37,200

still involved got involved and brought

668

00:23:41,810 --> 00:23:39,480

the quality of the shows like to new

669

00:23:43,250 --> 00:23:41,820

heights and that's where we started

670

00:23:45,529 --> 00:23:43,260

having good technology to go back and

671

00:23:47,029 --> 00:23:45,539

forth you know like internet bandwidth

672

00:23:48,649 --> 00:23:47,039

was improving to the point that we could

673

00:23:51,890 --> 00:23:48,659

have video going back and forth and

674

00:23:53,690 --> 00:23:51,900

being smooth and uh it kind of grew from

675

00:23:55,789 --> 00:23:53,700

there you know and you got involved and

676  
00:23:57,350 --> 00:23:55,799  
and just immediately saw the talent that

677  
00:23:59,029 --> 00:23:57,360  
you have in science communication and it

678  
00:24:00,950 --> 00:23:59,039  
was time as Blue Marble space was

679  
00:24:02,510 --> 00:24:00,960  
growing my role as a business leader

680  
00:24:05,029 --> 00:24:02,520  
were changing and so it was a good time

681  
00:24:06,950 --> 00:24:05,039  
to transition the roles and you've all

682  
00:24:08,750 --> 00:24:06,960  
taken it to new stratospheric heights

683  
00:24:11,029 --> 00:24:08,760  
that I could not have myself

684  
00:24:13,310 --> 00:24:11,039  
so uh yeah it's been it's been well 10

685  
00:24:15,350 --> 00:24:13,320  
years I think now for for uh the show

686  
00:24:17,210 --> 00:24:15,360  
which is crazy yeah it's been a wild

687  
00:24:19,130 --> 00:24:17,220  
ride and we've had some really

688  
00:24:21,169 --> 00:24:19,140

incredible moments along the way we did

689

00:24:23,810 --> 00:24:21,179

ask on the NASA astrobiology Twitter

690

00:24:25,370 --> 00:24:23,820

account uh some about people's favorite

691

00:24:26,750 --> 00:24:25,380

moments in the show and we had a few

692

00:24:28,610 --> 00:24:26,760

responses

693

00:24:30,890 --> 00:24:28,620

um you know I mentioned when hiroyuki

694

00:24:32,270 --> 00:24:30,900

kurokawa was on and kind of enlightened

695

00:24:34,250 --> 00:24:32,280

me to the possibility that there could

696

00:24:36,049 --> 00:24:34,260

be if there ever was Life on Mars

697

00:24:37,130 --> 00:24:36,059

ancient Martian life on the Moon of

698

00:24:38,330 --> 00:24:37,140

Phobos

699

00:24:39,710 --> 00:24:38,340

um that could have been Blast Off the

700

00:24:41,270 --> 00:24:39,720

surface of Mars

701  
00:24:43,789 --> 00:24:41,280  
um we heard from people like Jen blank

702  
00:24:46,130 --> 00:24:43,799  
and Mark Skidmore about the trials and

703  
00:24:48,770 --> 00:24:46,140  
tribulations of exploring in the field

704  
00:24:52,070 --> 00:24:48,780  
and doing field astrobiology uh Morgan

705  
00:24:53,690 --> 00:24:52,080  
cable from JPL joined us uh and talked

706  
00:24:55,549 --> 00:24:53,700  
about her hobby of mountain unicycling

707  
00:24:57,710 --> 00:24:55,559  
which everyone really loved

708  
00:25:00,710 --> 00:24:57,720  
um we also had Natalie Battaglia join us

709  
00:25:02,450 --> 00:25:00,720  
uh some know her uh as an astrophysicist

710  
00:25:04,370 --> 00:25:02,460  
who's done a lot of work on our space

711  
00:25:06,409 --> 00:25:04,380  
telescopes including now James Webb

712  
00:25:08,570 --> 00:25:06,419  
Space Telescope uh one quote from

713  
00:25:10,669 --> 00:25:08,580

Natalie when she was on the show is for

714

00:25:12,890 --> 00:25:10,679

me me I couldn't get interested in

715

00:25:15,409 --> 00:25:12,900

science until I could connect to the

716

00:25:17,210 --> 00:25:15,419

Wonder of it all and poetry did that for

717

00:25:18,590 --> 00:25:17,220

me and so for those who watched that

718

00:25:20,690 --> 00:25:18,600

episode you might recall that Natalie

719

00:25:21,649 --> 00:25:20,700

and I discussed poetry she's been

720

00:25:24,830 --> 00:25:21,659

involved in something called the

721

00:25:26,630 --> 00:25:24,840

universe in verse with Maria Popova of

722

00:25:28,909 --> 00:25:26,640

the marginalian

723

00:25:31,850 --> 00:25:28,919

um where they share science and poetry

724

00:25:33,049 --> 00:25:31,860

together in a night of exploration

725

00:25:34,610 --> 00:25:33,059

um and we have some really interesting

726

00:25:36,890 --> 00:25:34,620

news to share on the show today that

727

00:25:39,890 --> 00:25:36,900

just was announced it was just announced

728

00:25:42,470 --> 00:25:39,900

that the U.S Poet Laureate Ada Limon is

729

00:25:45,049 --> 00:25:42,480

going to create a poem that's going to

730

00:25:47,269 --> 00:25:45,059

go to Jupiter and to Europa on the

731

00:25:48,529 --> 00:25:47,279

Europa Clipper spacecraft we don't know

732

00:25:49,850 --> 00:25:48,539

what the message is yet she hasn't

733

00:25:51,890 --> 00:25:49,860

written it yet at least to our knowledge

734

00:25:53,330 --> 00:25:51,900

but it'll be very cool to see what that

735

00:25:55,610 --> 00:25:53,340

poem becomes and so maybe in the near

736

00:25:57,890 --> 00:25:55,620

future we'll discuss this poem and and

737

00:25:59,690 --> 00:25:57,900

the impact of sharing the Poetry of

738

00:26:01,970 --> 00:25:59,700

exploration in space through ask an

739

00:26:04,310 --> 00:26:01,980

astrobiologists and so there's been so

740

00:26:05,930 --> 00:26:04,320

much we've done in this show over time

741

00:26:07,370 --> 00:26:05,940

um you know from some of our bloopers

742

00:26:09,529 --> 00:26:07,380

like just today we had some technical

743

00:26:11,450 --> 00:26:09,539

issues in the show getting started

744

00:26:12,470 --> 00:26:11,460

um to in the past well I remember sanjoy

745

00:26:14,210 --> 00:26:12,480

when you were the host there was a

746

00:26:16,310 --> 00:26:14,220

period where we had posters on the wall

747

00:26:17,870 --> 00:26:16,320

behind you and there was one time this

748

00:26:19,430 --> 00:26:17,880

poster like came kind of like folding

749

00:26:20,870 --> 00:26:19,440

off the wall from behind you right

750

00:26:22,010 --> 00:26:20,880

during the episode

751

00:26:23,990 --> 00:26:22,020

um we've certainly had issues during

752

00:26:24,950 --> 00:26:24,000

every single episode I've I've hosted as

753

00:26:26,450 --> 00:26:24,960

well

754

00:26:29,630 --> 00:26:26,460

um that's just part of the fun of live

755

00:26:31,610 --> 00:26:29,640

video I suppose absolutely um yeah and

756

00:26:33,110 --> 00:26:31,620

you know these fun things happen and so

757

00:26:34,430 --> 00:26:33,120

I kind of want to change a little bit

758

00:26:35,930 --> 00:26:34,440

before we open it up to the audience

759

00:26:37,970 --> 00:26:35,940

here and just hear a little bit about

760

00:26:39,169 --> 00:26:37,980

your personal story

761

00:26:41,750 --> 00:26:39,179

um I'd love to know a little bit about

762

00:26:44,390 --> 00:26:41,760

your background and really what got you

763

00:26:45,710 --> 00:26:44,400

inspired to be involved in space in the

764

00:26:48,350 --> 00:26:45,720

first place at all or to be involved in

765

00:26:50,810 --> 00:26:48,360

engineering or science at all

766

00:26:53,330 --> 00:26:50,820

yeah so I definitely

767

00:26:55,490 --> 00:26:53,340

got interested in Exploration before I

768

00:26:58,669 --> 00:26:55,500

got interested in space exploration

769

00:27:00,409 --> 00:26:58,679

the first novel that I read ever

770

00:27:03,289 --> 00:27:00,419

um was Around the World in 80 Days by

771

00:27:05,690 --> 00:27:03,299

Jules Verne and I became a Jules Verne

772

00:27:07,610 --> 00:27:05,700

fan you know I read all of his books in

773

00:27:09,649 --> 00:27:07,620

mysterious island 20 000 Leagues Under

774

00:27:10,730 --> 00:27:09,659

the Sea five five weeks in a balloon you

775

00:27:14,210 --> 00:27:10,740

know of course Around the World in 80

776  
00:27:15,769 --> 00:27:14,220  
Days and from Earth to the Moon and that

777  
00:27:17,390 --> 00:27:15,779  
really like got me thinking about like

778  
00:27:18,649 --> 00:27:17,400  
the engineering aspect of exploration

779  
00:27:20,630 --> 00:27:18,659  
that all the things you have to think

780  
00:27:23,269 --> 00:27:20,640  
about to make long Journeys

781  
00:27:26,630 --> 00:27:23,279  
and then um when I was around eight

782  
00:27:27,830 --> 00:27:26,640  
years old my parents uh offered me a

783  
00:27:30,590 --> 00:27:27,840  
little telescope

784  
00:27:32,450 --> 00:27:30,600  
and through that I saw the craters of

785  
00:27:34,310 --> 00:27:32,460  
the Moon for the first time the moons of

786  
00:27:35,690 --> 00:27:34,320  
Jupiter the rings of Saturn and he was

787  
00:27:39,110 --> 00:27:35,700  
like what is going on what is this world

788  
00:27:40,789 --> 00:27:39,120

in the sky that had not seen before and

789

00:27:44,630 --> 00:27:40,799

um in whereas I grew up in Switzerland

790

00:27:46,190 --> 00:27:44,640

and Geneva Observatory is is fairly well

791

00:27:49,010 --> 00:27:46,200

known in the area and they had a group

792

00:27:51,950 --> 00:27:49,020

for enthusiasts to to join to go look at

793

00:27:53,750 --> 00:27:51,960

actual real telescope and I was by far

794

00:27:56,690 --> 00:27:53,760

the youngest participant there by far

795

00:27:58,250 --> 00:27:56,700

decades in terms of of participating in

796

00:28:00,830 --> 00:27:58,260

these evening shows you know and they

797

00:28:03,350 --> 00:28:00,840

were like late like 9 10 11 and you know

798

00:28:05,690 --> 00:28:03,360

when I was eight two I got tired but uh

799

00:28:07,610 --> 00:28:05,700

you know Mom came came with me and we I

800

00:28:09,950 --> 00:28:07,620

saw the bands of Jupiter for the first

801  
00:28:11,450 --> 00:28:09,960  
time and the details and it just

802  
00:28:13,490 --> 00:28:11,460  
absolutely blew my mind so I knew I was

803  
00:28:15,590 --> 00:28:13,500  
interested in space what aspects of

804  
00:28:17,510 --> 00:28:15,600  
space I don't know but I think like this

805  
00:28:20,090 --> 00:28:17,520  
murder of this interest from Jules Verne

806  
00:28:22,490 --> 00:28:20,100  
and this astronomy kind of directed me

807  
00:28:24,230 --> 00:28:22,500  
towards towards aerospace engineering my

808  
00:28:26,269 --> 00:28:24,240  
father worked for the aerospace

809  
00:28:28,669 --> 00:28:26,279  
engineering firms a lot of different

810  
00:28:32,210 --> 00:28:28,679  
factors that not necessarily kind of

811  
00:28:35,149 --> 00:28:32,220  
guided my path in in that that field

812  
00:28:36,649 --> 00:28:35,159  
and so that was not prevalent in in

813  
00:28:39,830 --> 00:28:36,659

Switzerland aerospace engineering was

814

00:28:41,870 --> 00:28:39,840

not a major uh then it is now but not

815

00:28:44,269 --> 00:28:41,880

then and so deciding where I wanted to

816

00:28:45,950 --> 00:28:44,279

go I was kind of exploring of course the

817

00:28:48,409 --> 00:28:45,960

United States because of NASA the

818

00:28:50,090 --> 00:28:48,419

reputation of NASA just transcends the

819

00:28:53,269 --> 00:28:50,100

reputation of the United States

820

00:28:54,890 --> 00:28:53,279

um still today and at that time and when

821

00:28:56,630 --> 00:28:54,900

I was deciding what to do in terms of

822

00:28:59,149 --> 00:28:56,640

the university the the first Swiss

823

00:29:00,710 --> 00:28:59,159

astronaut uh politically it flew and of

824

00:29:03,890 --> 00:29:00,720

course made the headline news everywhere

825

00:29:06,230 --> 00:29:03,900

and I got to meet him like a few days

826

00:29:08,570 --> 00:29:06,240

before moving to the United States it's

827

00:29:12,049 --> 00:29:08,580

January 1999 he gave a talk in my

828

00:29:14,390 --> 00:29:12,059

Village and just wow extremely inspiring

829

00:29:16,310 --> 00:29:14,400

person showed pictures about him in

830

00:29:18,529 --> 00:29:16,320

space everything like okay this is it

831

00:29:20,210 --> 00:29:18,539

this is this is what I'm doing

832

00:29:22,850 --> 00:29:20,220

um but I've always you know kept an open

833

00:29:25,250 --> 00:29:22,860

eye about what interests me um I started

834

00:29:26,810 --> 00:29:25,260

my aerospace engineering Masters in

835

00:29:29,510 --> 00:29:26,820

plasma physics because I was interested

836

00:29:31,430 --> 00:29:29,520

in advanced space propulsion but there

837

00:29:34,130 --> 00:29:31,440

were difficulties in finding funding for

838

00:29:35,930 --> 00:29:34,140

me for my second year so I started

839

00:29:38,990 --> 00:29:35,940

knocking on doors and found this

840

00:29:41,330 --> 00:29:39,000

opportunity in in fluid dynamics and

841

00:29:43,070 --> 00:29:41,340

heat transfer through which I got into

842

00:29:45,049 --> 00:29:43,080

involved in planetary atmospheres and

843

00:29:46,549 --> 00:29:45,059

then how I discovered astrobiology so

844

00:29:49,250 --> 00:29:46,559

life is really not at all is a linear

845

00:29:51,590 --> 00:29:49,260

path right you stay open to what happens

846

00:29:53,210 --> 00:29:51,600

around you and even the postdoc only

847

00:29:54,769 --> 00:29:53,220

happened because I went to a seminar

848

00:29:56,210 --> 00:29:54,779

where my future postdoc advisor was

849

00:29:58,130 --> 00:29:56,220

giving a talk and I was just blown away

850

00:30:00,649 --> 00:29:58,140

by his presentation which had nothing to

851  
00:30:03,350 --> 00:30:00,659  
do with my PhD but nonetheless like this

852  
00:30:05,090 --> 00:30:03,360  
is fantastic and so I really followed

853  
00:30:06,710 --> 00:30:05,100  
learned and and was able to join this

854  
00:30:08,510 --> 00:30:06,720  
lab after a bit of convincing again very

855  
00:30:10,669 --> 00:30:08,520  
grateful that he took a Leap of Faith

856  
00:30:12,649 --> 00:30:10,679  
with me but we're still colleagues you

857  
00:30:13,490 --> 00:30:12,659  
know 10 years afterwards so it worked

858  
00:30:16,430 --> 00:30:13,500  
out

859  
00:30:18,529 --> 00:30:16,440  
so just you know having always I've

860  
00:30:22,190 --> 00:30:18,539  
always listened to what's exciting

861  
00:30:24,230 --> 00:30:22,200  
around me I never never felt fear

862  
00:30:26,870 --> 00:30:24,240  
towards stuff that seemed difficult

863  
00:30:29,690 --> 00:30:26,880

because of community because of uh

864

00:30:31,850 --> 00:30:29,700

people I live with I work with friends

865

00:30:33,409 --> 00:30:31,860

you know you can do so much more with a

866

00:30:35,269 --> 00:30:33,419

group of people than the sum of the

867

00:30:36,950 --> 00:30:35,279

individual parts of the people and so

868

00:30:38,870 --> 00:30:36,960

that's what's also motivated me to to

869

00:30:41,810 --> 00:30:38,880

build this community of scientists at

870

00:30:43,730 --> 00:30:41,820

Blue Marble space um just because

871

00:30:45,590 --> 00:30:43,740

the sum of what we can do together is

872

00:30:47,930 --> 00:30:45,600

just extraordinary and so much more than

873

00:30:49,850 --> 00:30:47,940

again that we could do individually

874

00:30:51,110 --> 00:30:49,860

um so I'm disappearing in attention to

875

00:30:52,789 --> 00:30:51,120

your original question I'm sorry but

876

00:30:54,889 --> 00:30:52,799

hopefully they give you a feel about um

877

00:30:57,950 --> 00:30:54,899

kind of the path that I followed to uh

878

00:30:59,210 --> 00:30:57,960

to where I am today totally fine

879

00:31:01,070 --> 00:30:59,220

um I do want to get to our audience

880

00:31:03,230 --> 00:31:01,080

questions here soon we just have a

881

00:31:04,730 --> 00:31:03,240

slightly late start on today's episode

882

00:31:06,769 --> 00:31:04,740

um I do real quick before we do our

883

00:31:08,450 --> 00:31:06,779

faster than light segment I would love

884

00:31:11,570 --> 00:31:08,460

to have you tell the audience a little

885

00:31:13,190 --> 00:31:11,580

bit about your work in watchmaking

886

00:31:15,409 --> 00:31:13,200

um so I know that you've made watches

887

00:31:17,090 --> 00:31:15,419

that it's a it's a hobby of yours

888

00:31:19,430 --> 00:31:17,100

um I'd love to hear kind of what got you

889

00:31:21,649 --> 00:31:19,440

involved um in this kind of this side

890

00:31:22,669 --> 00:31:21,659

pursuit of of making watches in your

891

00:31:24,769 --> 00:31:22,679

spare time

892

00:31:26,690 --> 00:31:24,779

yeah I've really always been interested

893

00:31:28,190 --> 00:31:26,700

in horror some mechanical watches I

894

00:31:30,230 --> 00:31:28,200

don't care much for quartz watches um

895

00:31:32,389 --> 00:31:30,240

but mechanical watches and uh it really

896

00:31:34,250 --> 00:31:32,399

the hobby really took started during the

897

00:31:36,110 --> 00:31:34,260

pandemic I live in an apartment so I

898

00:31:38,630 --> 00:31:36,120

didn't have a lot of space for uh for

899

00:31:40,490 --> 00:31:38,640

hobby watchmaking is very small so I

900

00:31:42,470 --> 00:31:40,500

first started by just buying a kit and

901  
00:31:43,789 --> 00:31:42,480  
started putting it together and then I

902  
00:31:45,289 --> 00:31:43,799  
had all these Visions about how to make

903  
00:31:46,370 --> 00:31:45,299  
the kids better

904  
00:31:48,950 --> 00:31:46,380  
um so they're all stainless steel

905  
00:31:51,230 --> 00:31:48,960  
watches and then I've I found a local

906  
00:31:54,409 --> 00:31:51,240  
company in the Bay Area that

907  
00:31:57,470 --> 00:31:54,419  
industrially black oxidizes steel

908  
00:32:00,529 --> 00:31:57,480  
so I showed up with my watch cases and

909  
00:32:02,029 --> 00:32:00,539  
they're like what like come on give it a

910  
00:32:04,310 --> 00:32:02,039  
try you have nothing to lose you know

911  
00:32:05,690 --> 00:32:04,320  
I'll take the the costs fall out it

912  
00:32:08,210 --> 00:32:05,700  
doesn't work I'm just curious if it does

913  
00:32:10,669 --> 00:32:08,220

and it did so there I got these these

914

00:32:12,049 --> 00:32:10,679

watch cases beautifully black oxidized I

915

00:32:13,970 --> 00:32:12,059

don't have the scales to build the

916

00:32:15,769 --> 00:32:13,980

individual gears and put them together I

917

00:32:18,049 --> 00:32:15,779

buy the movements already built which is

918

00:32:20,510 --> 00:32:18,059

good uh so it means the quality of the

919

00:32:22,130 --> 00:32:20,520

watches that I have are all excellent um

920

00:32:24,950 --> 00:32:22,140

so there are movements that are been

921

00:32:27,950 --> 00:32:24,960

manufactured on mass I'm no Patek

922

00:32:30,169 --> 00:32:27,960

Philippe right and so um but then I have

923

00:32:32,029 --> 00:32:30,179

a friend of mine who's a who's a she's a

924

00:32:34,610 --> 00:32:32,039

software engineer but she's also a an

925

00:32:37,070 --> 00:32:34,620

artist and she does the dials really

926

00:32:39,649 --> 00:32:37,080

beautiful very scaled painter who's

927

00:32:42,049 --> 00:32:39,659

really good at painting Birds and then

928

00:32:44,210 --> 00:32:42,059

based on the dial colors

929

00:32:46,070 --> 00:32:44,220

um I choose what kind of uh watch hands

930

00:32:48,289 --> 00:32:46,080

I want two hands three hands what color

931

00:32:49,669 --> 00:32:48,299

maybe the same color and then assemble

932

00:32:52,549 --> 00:32:49,679

everything together

933

00:32:54,710 --> 00:32:52,559

and so you know as a business leader and

934

00:32:56,450 --> 00:32:54,720

as a scientist my mind is all over the

935

00:32:59,269 --> 00:32:56,460

place during the day and sometimes I

936

00:33:02,090 --> 00:32:59,279

just need an ability to just refocus the

937

00:33:04,430 --> 00:33:02,100

Mind into a single task and watchmaking

938

00:33:06,470 --> 00:33:04,440

there's no way around it like if you're

939

00:33:08,570 --> 00:33:06,480

anxious or stressed or have your mind

940

00:33:09,830 --> 00:33:08,580

somewhere else the hands are just not

941

00:33:11,570 --> 00:33:09,840

gonna fit

942

00:33:13,730 --> 00:33:11,580

so it's a way it's almost meditation

943

00:33:15,470 --> 00:33:13,740

it's a meditative hobby essentially I

944

00:33:16,970 --> 00:33:15,480

think not to not think about it most of

945

00:33:19,009 --> 00:33:16,980

my hobbies are meditative they're just

946

00:33:22,250 --> 00:33:19,019

let the Mind do its thing and just focus

947

00:33:23,870 --> 00:33:22,260

and um it's been a joy you know to to to

948

00:33:25,130 --> 00:33:23,880

and then I started learning about the

949

00:33:27,470 --> 00:33:25,140

history of watchmaking which is very

950

00:33:29,210 --> 00:33:27,480

interesting as well and this is this

951  
00:33:30,409 --> 00:33:29,220  
other philosophical aspect that all the

952  
00:33:31,970 --> 00:33:30,419  
different pieces that go into a

953  
00:33:34,730 --> 00:33:31,980  
mechanical mechanical watches are just

954  
00:33:36,169 --> 00:33:34,740  
rubbish individually and we you put all

955  
00:33:37,789 --> 00:33:36,179  
these pieces together you have this

956  
00:33:40,370 --> 00:33:37,799  
intricate piece that tells the time very

957  
00:33:42,649 --> 00:33:40,380  
precisely it's kind of my wish for every

958  
00:33:44,450 --> 00:33:42,659  
organization where every person involved

959  
00:33:46,730 --> 00:33:44,460  
in the in the organization is one of

960  
00:33:49,730 --> 00:33:46,740  
those pieces and then together it just

961  
00:33:52,370 --> 00:33:49,740  
work like clockwork yeah I love it

962  
00:33:54,169 --> 00:33:52,380  
that's great the Buddha said before

963  
00:33:56,450 --> 00:33:54,179

Enlightenment chop wood carry water

964

00:33:58,789 --> 00:33:56,460

after Enlightenment chalk would carry

965

00:34:00,169 --> 00:33:58,799

water and so for sanjoy Sam it's it's

966

00:34:01,970 --> 00:34:00,179

you know before Enlightenment and

967

00:34:03,950 --> 00:34:01,980

afterwards is to assemble the watch

968

00:34:05,509 --> 00:34:03,960

pieces and I love that I love it's very

969

00:34:06,769 --> 00:34:05,519

meditative for you

970

00:34:09,050 --> 00:34:06,779

um we are going to switch now to our

971

00:34:11,089 --> 00:34:09,060

faster than light segment I have a few

972

00:34:12,349 --> 00:34:11,099

quick questions each of them can be just

973

00:34:14,570 --> 00:34:12,359

short answers

974

00:34:16,310 --> 00:34:14,580

um you know 30 seconds to a minute

975

00:34:19,010 --> 00:34:16,320

um the very first one starts off with

976  
00:34:20,629 --> 00:34:19,020  
Enrico fermi's question so what is your

977  
00:34:22,970 --> 00:34:20,639  
favorite answer to fermi's question

978  
00:34:24,710 --> 00:34:22,980  
where are they

979  
00:34:27,770 --> 00:34:24,720  
my favorite answer is that they're

980  
00:34:30,290 --> 00:34:27,780  
watching us from above looking at us and

981  
00:34:32,149 --> 00:34:30,300  
like you guys are just not ready to be

982  
00:34:35,030 --> 00:34:32,159  
part of a community of Intergalactic

983  
00:34:36,950 --> 00:34:35,040  
species sorry keep working at it

984  
00:34:38,629 --> 00:34:36,960  
love it it's like the Star Trek right

985  
00:34:40,849 --> 00:34:38,639  
exactly we're waiting for First Contact

986  
00:34:42,470 --> 00:34:40,859  
okay so here's a really fun one and I

987  
00:34:43,909 --> 00:34:42,480  
know this one you know I'm sure you have

988  
00:34:45,169 --> 00:34:43,919

some great advice here because you have

989

00:34:46,310 --> 00:34:45,179

been so involved in the careers of

990

00:34:48,530 --> 00:34:46,320

others

991

00:34:50,389 --> 00:34:48,540

if you could go back in time and visit

992

00:34:53,389 --> 00:34:50,399

yourself at the beginning of your career

993

00:34:55,010 --> 00:34:53,399

what advice would you give yourself

994

00:34:59,390 --> 00:34:55,020

I would say

995

00:35:01,790 --> 00:34:59,400

don't settle too far away from family

996

00:35:03,410 --> 00:35:01,800

so I left Switzerland when I was 19 to

997

00:35:05,210 --> 00:35:03,420

the United States for University and at

998

00:35:07,609 --> 00:35:05,220

19 years old it was awesome right

999

00:35:09,170 --> 00:35:07,619

finally you have my own freedom to

1000

00:35:10,910 --> 00:35:09,180

explore my own interests understand who

1001

00:35:13,130 --> 00:35:10,920

I am what I want to do

1002

00:35:15,589 --> 00:35:13,140

and then because of life I ended up

1003

00:35:17,210 --> 00:35:15,599

settling in in San Francisco but now you

1004

00:35:19,069 --> 00:35:17,220

know in my early 40s I have a little

1005

00:35:20,750 --> 00:35:19,079

niece that I don't see very often who's

1006

00:35:22,310 --> 00:35:20,760

growing very quickly my parents are

1007

00:35:24,230 --> 00:35:22,320

getting old said I'm not there to take

1008

00:35:27,170 --> 00:35:24,240

care of them and so especially during

1009

00:35:29,450 --> 00:35:27,180

the pandemic and just with a parent

1010

00:35:31,250 --> 00:35:29,460

that's ill it's just and the little girl

1011

00:35:32,690 --> 00:35:31,260

that's growing and I'm not there to be

1012

00:35:34,069 --> 00:35:32,700

the uncle that I want to be it's just

1013

00:35:36,950 --> 00:35:34,079

it's been difficult

1014

00:35:38,630 --> 00:35:36,960

so the advice is like yes go wherever

1015

00:35:41,950 --> 00:35:38,640

you need to to have a fantastic

1016

00:35:44,750 --> 00:35:41,960

education but come back closer to home

1017

00:35:47,150 --> 00:35:44,760

to settle because family is ultimately

1018

00:35:49,190 --> 00:35:47,160

all you have when

1019

00:35:51,170 --> 00:35:49,200

you dissect toward the world

1020

00:35:54,349 --> 00:35:51,180

and so for me I wish I had settled

1021

00:35:56,690 --> 00:35:54,359

closer to him I feel that a lot I'm also

1022

00:35:57,710 --> 00:35:56,700

very far away from family and it can be

1023

00:36:01,190 --> 00:35:57,720

troubling

1024

00:36:03,230 --> 00:36:01,200

another question if there is alien life

1025

00:36:04,970 --> 00:36:03,240

out there do you think we as

1026

00:36:07,790 --> 00:36:04,980

astrobiologists are most likely to find

1027

00:36:09,950 --> 00:36:07,800

it first here in our solar system beyond

1028

00:36:11,990 --> 00:36:09,960

Earth or out there amongst the

1029

00:36:14,390 --> 00:36:12,000

exoplanets oh it's so hard you know now

1030

00:36:16,430 --> 00:36:14,400

that James Webb is has launched most

1031

00:36:17,750 --> 00:36:16,440

exciting telescope ever and its

1032

00:36:19,670 --> 00:36:17,760

capabilities are just blowing everybody

1033

00:36:22,310 --> 00:36:19,680

out of the water it's really hard to

1034

00:36:24,530 --> 00:36:22,320

understand that they're sort of to

1035

00:36:26,690 --> 00:36:24,540

predict I guess what it will see versus

1036

00:36:27,829 --> 00:36:26,700

the uh the the exciting Mars missions

1037

00:36:29,990 --> 00:36:27,839

that are ongoing and the Clipper

1038

00:36:31,849 --> 00:36:30,000

missions of the icy moons I think it's a

1039

00:36:33,890 --> 00:36:31,859

very fun race to keep to keep up with

1040

00:36:34,970 --> 00:36:33,900

and who's going to detect anything first

1041

00:36:37,250 --> 00:36:34,980

the discoveries are going to be very

1042

00:36:38,630 --> 00:36:37,260

different and if they do make

1043

00:36:40,550 --> 00:36:38,640

discoveries it's going to be debated

1044

00:36:42,290 --> 00:36:40,560

forever before you know we make the

1045

00:36:44,630 --> 00:36:42,300

conclusion that it is alien life right

1046

00:36:46,550 --> 00:36:44,640

that's their last possible option is

1047

00:36:47,329 --> 00:36:46,560

that it's it's alien life it's you have

1048

00:36:48,710 --> 00:36:47,339

to go through all the different

1049

00:36:51,230 --> 00:36:48,720

possibilities you can't see something

1050

00:36:53,750 --> 00:36:51,240

strange be like that's aliens like no

1051  
00:36:55,250 --> 00:36:53,760  
you have to be extremely methodical you

1052  
00:36:58,190 --> 00:36:55,260  
know it's even if we make an interesting

1053  
00:36:59,750 --> 00:36:58,200  
Discovery the process of science will

1054  
00:37:01,790 --> 00:36:59,760  
have to take its place and it's going to

1055  
00:37:03,230 --> 00:37:01,800  
be a probability at the end this is

1056  
00:37:04,970 --> 00:37:03,240  
highly probable that it is biology

1057  
00:37:07,250 --> 00:37:04,980  
versus less probable it's biology it's

1058  
00:37:08,630 --> 00:37:07,260  
not gonna oh unless we have you know

1059  
00:37:11,390 --> 00:37:08,640  
have a handshake or there's like a

1060  
00:37:13,370 --> 00:37:11,400  
selfie of on somebody on the Mars rover

1061  
00:37:14,690 --> 00:37:13,380  
um it's always going to be a little bit

1062  
00:37:16,010 --> 00:37:14,700  
of a doubt and that's okay you know

1063  
00:37:18,710 --> 00:37:16,020

that's the process of science will work

1064

00:37:20,210 --> 00:37:18,720

towards answering it so I can't predict

1065

00:37:21,530 --> 00:37:20,220

effectively in our solar system or not

1066

00:37:23,329 --> 00:37:21,540

just because like the instrumentation

1067

00:37:25,730 --> 00:37:23,339

that James Webb is just deployed under

1068

00:37:27,470 --> 00:37:25,740

upcoming missions or or for our own

1069

00:37:30,109 --> 00:37:27,480

solar system are all extremely exciting

1070

00:37:33,349 --> 00:37:30,119

was a really powerful instrumentation so

1071

00:37:34,730 --> 00:37:33,359

uh I'm just I'm gonna love just reading

1072

00:37:36,290 --> 00:37:34,740

all the papers and seeing what comes

1073

00:37:39,109 --> 00:37:36,300

down from these missions

1074

00:37:41,270 --> 00:37:39,119

love it okay uh last question in our

1075

00:37:43,010 --> 00:37:41,280

fast and light segment what is an

1076

00:37:45,530 --> 00:37:43,020

unbelievable science fact that still

1077

00:37:48,770 --> 00:37:45,540

blows your mind

1078

00:37:53,270 --> 00:37:50,750

done a lot of work to understand the

1079

00:37:54,770 --> 00:37:53,280

origin of life and we know a lot about

1080

00:37:56,390 --> 00:37:54,780

terrestrial biology all the way back

1081

00:37:59,150 --> 00:37:56,400

down to the last Universal common

1082

00:38:01,310 --> 00:37:59,160

ancestor which is what 3.8 billion years

1083

00:38:03,650 --> 00:38:01,320

ago but you know earth started having

1084

00:38:05,630 --> 00:38:03,660

water further back in time and there's

1085

00:38:06,829 --> 00:38:05,640

this Chasm of knowledge between I think

1086

00:38:09,230 --> 00:38:06,839

I said before like these early

1087

00:38:10,910 --> 00:38:09,240

geochemical reactions to this chemical

1088

00:38:13,069 --> 00:38:10,920

system capable of darwinian evolution

1089

00:38:15,050 --> 00:38:13,079

and and so like

1090

00:38:17,750 --> 00:38:15,060

that blows my mind that I actually did

1091

00:38:19,730 --> 00:38:17,760

that that that actually occurred biology

1092

00:38:21,890 --> 00:38:19,740

is so incredibly complex how did that

1093

00:38:23,990 --> 00:38:21,900

how did that happen just blows my mind

1094

00:38:26,630 --> 00:38:24,000

just thinking about it right now

1095

00:38:28,910 --> 00:38:26,640

I love it all right sanjoy now is the

1096

00:38:30,470 --> 00:38:28,920

time for our audience q a uh to our

1097

00:38:32,690 --> 00:38:30,480

audience who are watching live right now

1098

00:38:34,069 --> 00:38:32,700

thank you so much for hanging out with

1099

00:38:35,569 --> 00:38:34,079

us

1100

00:38:37,130 --> 00:38:35,579

um I'm sorry it took so long to get to

1101

00:38:39,650 --> 00:38:37,140

your questions but we have a bunch of

1102

00:38:41,569 --> 00:38:39,660

them uh and so I'm very excited right

1103

00:38:42,829 --> 00:38:41,579

now to to share some of these with you

1104

00:38:44,569 --> 00:38:42,839

I'm going to start off with one that

1105

00:38:47,870 --> 00:38:44,579

came in from Twitter actually before the

1106

00:38:50,089 --> 00:38:47,880

show this one is from Dr Jim pass uh Jim

1107

00:38:51,770 --> 00:38:50,099

has asked uh how much do you Endeavor to

1108

00:38:54,050 --> 00:38:51,780

involve students in the social sciences

1109

00:38:56,270 --> 00:38:54,060

and Humanities during your astrobiology

1110

00:38:57,950 --> 00:38:56,280

public Outreach activities how important

1111

00:38:58,790 --> 00:38:57,960

is it to increase collaboration with

1112

00:39:00,770 --> 00:38:58,800

them

1113

00:39:02,089 --> 00:39:00,780

oh quite like one of the questions one

1114

00:39:04,490 --> 00:39:02,099

of the statements I make all the time

1115

00:39:06,530 --> 00:39:04,500

when I give public talks is that the

1116

00:39:08,870 --> 00:39:06,540

quest to understand life in the universe

1117

00:39:10,790 --> 00:39:08,880

is is fundamental to understand who we

1118

00:39:14,810 --> 00:39:10,800

are as humans right and the reason is as

1119

00:39:17,630 --> 00:39:14,820

follows like if we are indeed alone

1120

00:39:21,829 --> 00:39:17,640

in the universe that means that we are

1121

00:39:26,089 --> 00:39:24,650

that's ability to hold right I'm not

1122

00:39:28,910 --> 00:39:26,099

sure we're ready for that

1123

00:39:30,829 --> 00:39:28,920

conversely if we're not alone then what

1124

00:39:32,329 --> 00:39:30,839

does it mean to be human right is is

1125

00:39:35,030 --> 00:39:32,339

will it take the discovery of

1126

00:39:37,130 --> 00:39:35,040

extraterrestrials to have Humanity see

1127

00:39:41,270 --> 00:39:37,140

itself as humans first and foremost

1128

00:39:44,270 --> 00:39:41,280

before a collection of of of races and

1129

00:39:46,670 --> 00:39:44,280

uh you know if there is indeed life

1130

00:39:48,650 --> 00:39:46,680

elsewhere the trivialities of conflict

1131

00:39:51,290 --> 00:39:48,660

on Earth seems Seems just crazy to think

1132

00:39:53,450 --> 00:39:51,300

about it and so like I think we're all

1133

00:39:55,250 --> 00:39:53,460

many of us are particularly we're

1134

00:39:56,569 --> 00:39:55,260

leaders are stuck in their own ways in

1135

00:39:58,670 --> 00:39:56,579

seeing themselves as more important than

1136

00:40:01,190 --> 00:39:58,680

the other than their neighbors whereas

1137

00:40:03,349 --> 00:40:01,200

astrobiology just also teaches us that

1138

00:40:05,630 --> 00:40:03,359

we're all we are all related completely

1139

00:40:08,030 --> 00:40:05,640

related in fact all of us who are on

1140

00:40:10,069 --> 00:40:08,040

this call had literal ancestors who are

1141

00:40:13,130 --> 00:40:10,079

building the pyramids you know all of us

1142

00:40:15,230 --> 00:40:13,140

on this call who who have seen images of

1143

00:40:18,050 --> 00:40:15,240

of handprints on the Neolithic walls

1144

00:40:19,730 --> 00:40:18,060

with ocher around it all of us can

1145

00:40:21,230 --> 00:40:19,740

relate ourselves directly to these

1146

00:40:22,970 --> 00:40:21,240

people right we're all brothers and

1147

00:40:24,170 --> 00:40:22,980

sisters we're all connected and this

1148

00:40:25,790 --> 00:40:24,180

realization that counts from

1149

00:40:28,430 --> 00:40:25,800

astrobiology I think is a really

1150

00:40:30,230 --> 00:40:28,440

important kid and I do that in my in my

1151  
00:40:32,990 --> 00:40:30,240  
presentation so absolutely the social

1152  
00:40:34,849 --> 00:40:33,000  
sciences have their space um I wish we

1153  
00:40:36,890 --> 00:40:34,859  
could offer more uh social science

1154  
00:40:39,170 --> 00:40:36,900  
projects in our in our young scientist

1155  
00:40:40,670 --> 00:40:39,180  
program it'll come just a community

1156  
00:40:41,870 --> 00:40:40,680  
we've been able to build so far as

1157  
00:40:44,210 --> 00:40:41,880  
mainly scientists and science

1158  
00:40:46,609 --> 00:40:44,220  
communicators but it'll come it's it's

1159  
00:40:48,109 --> 00:40:46,619  
it's part of the discipline is it the

1160  
00:40:51,050 --> 00:40:48,119  
social sciences

1161  
00:40:52,970 --> 00:40:51,060  
absolutely well let's talk about

1162  
00:40:56,210 --> 00:40:52,980  
um the sociology of finding alien life

1163  
00:40:58,370 --> 00:40:56,220

now uh rahu Meera on YouTube has asked

1164

00:41:00,530 --> 00:40:58,380

uh how do you think the world and United

1165

00:41:02,770 --> 00:41:00,540

Nations would react if discovery of life

1166

00:41:05,750 --> 00:41:02,780

outside Earth is confirmed one day

1167

00:41:07,069 --> 00:41:05,760

uh it's gonna be I think the emotions

1168

00:41:08,510 --> 00:41:07,079

are going to be all over the map some

1169

00:41:09,890 --> 00:41:08,520

people are going to be terrified some

1170

00:41:11,150 --> 00:41:09,900

people are going to be extremely excited

1171

00:41:12,650 --> 00:41:11,160

about it

1172

00:41:15,410 --> 00:41:12,660

um I hope it's going to bring people

1173

00:41:17,150 --> 00:41:15,420

together I'm realizing that

1174

00:41:19,730 --> 00:41:17,160

um wow so we have to represent ourselves

1175

00:41:22,730 --> 00:41:19,740

well hopefully to use to these alien

1176  
00:41:24,650 --> 00:41:22,740  
species um we have to not you know load

1177  
00:41:26,750 --> 00:41:24,660  
ourselves with weapons which is what

1178  
00:41:28,609 --> 00:41:26,760  
Humanity has tended to do when when

1179  
00:41:30,349 --> 00:41:28,619  
faced with people that did not recognize

1180  
00:41:32,450 --> 00:41:30,359  
hopefully we can learn from our history

1181  
00:41:34,310 --> 00:41:32,460  
and behave differently

1182  
00:41:36,349 --> 00:41:34,320  
um but yeah there's no way really to

1183  
00:41:38,210 --> 00:41:36,359  
predict I think it's going to be the

1184  
00:41:40,310 --> 00:41:38,220  
full spectrum of emotions or what's

1185  
00:41:42,170 --> 00:41:40,320  
going to be happening when we do indeed

1186  
00:41:44,030 --> 00:41:42,180  
make first Contact

1187  
00:41:45,349 --> 00:41:44,040  
I love it

1188  
00:41:47,210 --> 00:41:45,359

um so let's switch gears this next

1189

00:41:48,589 --> 00:41:47,220

question comes from user tessellated on

1190

00:41:50,089 --> 00:41:48,599

YouTube

1191

00:41:51,890 --> 00:41:50,099

um they ask what are good strategies

1192

00:41:53,810 --> 00:41:51,900

communicate complex research topics to

1193

00:41:55,190 --> 00:41:53,820

the general public that can promote

1194

00:41:56,750 --> 00:41:55,200

interest and engagement

1195

00:41:58,670 --> 00:41:56,760

yeah it's a great question it's not easy

1196

00:42:00,109 --> 00:41:58,680

to communicate science well um I

1197

00:42:02,270 --> 00:42:00,119

recommend everybody who's interested in

1198

00:42:03,710 --> 00:42:02,280

that to actually train themselves to be

1199

00:42:05,270 --> 00:42:03,720

science communicators there are

1200

00:42:06,890 --> 00:42:05,280

wonderful opportunities with

1201  
00:42:08,329 --> 00:42:06,900  
organizations including boom mobile

1202  
00:42:11,270 --> 00:42:08,339  
space but also the Ellen Elder

1203  
00:42:13,130 --> 00:42:11,280  
organization to learn and uh agu

1204  
00:42:15,589 --> 00:42:13,140  
American geophysical Union

1205  
00:42:17,390 --> 00:42:15,599  
um and a bunch of others who give

1206  
00:42:19,069 --> 00:42:17,400  
workshops on how to communicate science

1207  
00:42:20,569 --> 00:42:19,079  
because you don't want to dumb it down

1208  
00:42:22,609 --> 00:42:20,579  
right that's that's the meaning you want

1209  
00:42:25,370 --> 00:42:22,619  
to explain it in using analogies or

1210  
00:42:26,990 --> 00:42:25,380  
using excitement and and you know people

1211  
00:42:29,329 --> 00:42:27,000  
might not understand everything but if

1212  
00:42:31,430 --> 00:42:29,339  
they sense that it's exciting they will

1213  
00:42:34,069 --> 00:42:31,440

be excited as well I mean I'm sure

1214

00:42:35,690 --> 00:42:34,079

you've had a class at uh in in school

1215

00:42:38,089 --> 00:42:35,700

where the professor is just not engaged

1216

00:42:39,770 --> 00:42:38,099

despite how exciting the topic is and if

1217

00:42:41,569 --> 00:42:39,780

they're not engaged then you can lose

1218

00:42:43,010 --> 00:42:41,579

excitement but if the topic talks about

1219

00:42:44,930 --> 00:42:43,020

something esoteric but they're really

1220

00:42:47,270 --> 00:42:44,940

into it like you're into it as well

1221

00:42:48,710 --> 00:42:47,280

right so science communication is not

1222

00:42:51,290 --> 00:42:48,720

just the skills of putting words

1223

00:42:54,050 --> 00:42:51,300

together to to explain a difficult

1224

00:42:55,910 --> 00:42:54,060

concept there's also the whole approach

1225

00:42:58,370 --> 00:42:55,920

you take to communicating that's science

1226

00:43:01,069 --> 00:42:58,380

and that's skills that are trainable and

1227

00:43:02,809 --> 00:43:01,079

so um you know not everybody

1228

00:43:04,849 --> 00:43:02,819

um well we're not born science

1229

00:43:06,770 --> 00:43:04,859

communicators right we're you can train

1230

00:43:09,470 --> 00:43:06,780

that and so going through these

1231

00:43:11,270 --> 00:43:09,480

workshops um to to improve those skills

1232

00:43:14,750 --> 00:43:11,280

is the best way to learn the

1233

00:43:17,990 --> 00:43:14,760

methodologies to then explain more and

1234

00:43:19,430 --> 00:43:18,000

more complex topics practice right

1235

00:43:22,190 --> 00:43:19,440

that's how the only way you get to

1236

00:43:24,650 --> 00:43:22,200

Carnegie Hall is practice practice

1237

00:43:26,450 --> 00:43:24,660

absolutely him practicing work it takes

1238

00:43:28,190 --> 00:43:26,460

work to do anything well that's right um

1239

00:43:29,990 --> 00:43:28,200

we have another question from rahu Mira

1240

00:43:31,430 --> 00:43:30,000

I think I'll answer this one uh we

1241

00:43:32,930 --> 00:43:31,440

discussed earlier you told us you know

1242

00:43:34,490 --> 00:43:32,940

that water by itself is not habitable

1243

00:43:36,050 --> 00:43:34,500

that we're looking you know that the

1244

00:43:38,630 --> 00:43:36,060

energetics of the systems that we have

1245

00:43:40,190 --> 00:43:38,640

these watery systems Rahul wanted to

1246

00:43:42,050 --> 00:43:40,200

know why we're fixated on this idea that

1247

00:43:43,430 --> 00:43:42,060

water is essential for life

1248

00:43:44,690 --> 00:43:43,440

um and if there's any theoretical basis

1249

00:43:46,790 --> 00:43:44,700

for that belief

1250

00:43:48,650 --> 00:43:46,800

um Rahul you're very right

1251

00:43:50,930 --> 00:43:48,660

um we have thought a lot about you know

1252

00:43:53,150 --> 00:43:50,940

water as the solvent for life and life

1253

00:43:54,589 --> 00:43:53,160

being carbon based there is certainly

1254

00:43:56,750 --> 00:43:54,599

other chemistry out there there are

1255

00:43:58,309 --> 00:43:56,760

other possible solvents that a living

1256

00:44:00,530 --> 00:43:58,319

system could potentially use and there's

1257

00:44:02,270 --> 00:44:00,540

other possible backlog backbones for for

1258

00:44:04,130 --> 00:44:02,280

life as well maybe it's silicon-based

1259

00:44:05,329 --> 00:44:04,140

life people have talked about

1260

00:44:06,530 --> 00:44:05,339

um I'll throw a question back at you

1261

00:44:07,790 --> 00:44:06,540

though and give you some homework if you

1262

00:44:09,470 --> 00:44:07,800

don't mind

1263

00:44:11,150 --> 00:44:09,480

um I love it if you would go out and

1264

00:44:13,609 --> 00:44:11,160

research a little bit about water's

1265

00:44:16,250 --> 00:44:13,619

chemistry especially things like the

1266

00:44:18,290 --> 00:44:16,260

hydrogen bonding inside of water and why

1267

00:44:20,150 --> 00:44:18,300

water is the solvent for Life as We Know

1268

00:44:21,410 --> 00:44:20,160

It And the same thing for carbon as well

1269

00:44:23,870 --> 00:44:21,420

there's actually a reason that carbons

1270

00:44:25,970 --> 00:44:23,880

are much better backbone for Life as we

1271

00:44:27,050 --> 00:44:25,980

know it than silicon is

1272

00:44:28,730 --> 00:44:27,060

um so it's worth putting some of the

1273

00:44:30,950 --> 00:44:28,740

work in yourself and exploring this

1274

00:44:32,630 --> 00:44:30,960

topic a little bit I can say that you're

1275

00:44:35,270 --> 00:44:32,640

right uh there are reasons to explore

1276

00:44:37,609 --> 00:44:35,280

other possibilities but so far as far as

1277

00:44:39,050 --> 00:44:37,619

we know life is based in water and with

1278

00:44:40,609 --> 00:44:39,060

carbon

1279

00:44:43,130 --> 00:44:40,619

um so song joy for you we have another

1280

00:44:45,589 --> 00:44:43,140

question from Twitter uh from sibsunker

1281

00:44:47,990 --> 00:44:45,599

palette uh sibsonker has asked if you

1282

00:44:50,210 --> 00:44:48,000

have suggestions for a young aspiring

1283

00:44:52,010 --> 00:44:50,220

spacepreneur who wants to build a

1284

00:44:54,589 --> 00:44:52,020

youth-led astrobiology and space

1285

00:44:56,210 --> 00:44:54,599

non-profit that can Empower unserved

1286

00:44:58,430 --> 00:44:56,220

communities around the world uh just

1287

00:45:01,130 --> 00:44:58,440

like Blue Marble space has

1288

00:45:04,309 --> 00:45:01,140

find the people who are as excited as

1289

00:45:06,890 --> 00:45:04,319

you to work on the project but also find

1290

00:45:10,010 --> 00:45:06,900

people who have the skills to also do

1291

00:45:11,390 --> 00:45:10,020

the motivation to do the drudgery part

1292

00:45:13,069 --> 00:45:11,400

of running a business

1293

00:45:15,109 --> 00:45:13,079

get somebody as excited about accounting

1294

00:45:16,849 --> 00:45:15,119

get something as excited about the law

1295

00:45:19,670 --> 00:45:16,859

how do you set up a business how what

1296

00:45:21,470 --> 00:45:19,680

are all the different paperwork you need

1297

00:45:23,750 --> 00:45:21,480

to file yearly to make sure that your

1298

00:45:26,089 --> 00:45:23,760

nonprofit stays an entity right it's a

1299

00:45:28,069 --> 00:45:26,099

lot of dedication to topics that are not

1300

00:45:30,890 --> 00:45:28,079

necessarily exciting from a science

1301

00:45:33,109 --> 00:45:30,900

perspective to keep a business going

1302

00:45:35,150 --> 00:45:33,119

um it's it's a huge learning curve that

1303

00:45:37,730 --> 00:45:35,160

I encourage you to follow if business is

1304

00:45:40,370 --> 00:45:37,740

something that excites you but it can

1305

00:45:43,550 --> 00:45:40,380

take you away from the science

1306

00:45:45,349 --> 00:45:43,560

um and so be very very mindful whether

1307

00:45:48,290 --> 00:45:45,359

starting a business is what you want to

1308

00:45:51,109 --> 00:45:48,300

do you don't need to start a business to

1309

00:45:53,270 --> 00:45:51,119

build a community right you only need to

1310

00:45:54,950 --> 00:45:53,280

start a business once you need to you're

1311

00:45:57,349 --> 00:45:54,960

doing transaction financially in order

1312

00:45:58,970 --> 00:45:57,359

to stay you know legal but you don't

1313

00:46:01,130 --> 00:45:58,980

need to start a business to build a

1314

00:46:04,010 --> 00:46:01,140

community uh you can do that just with

1315

00:46:05,390 --> 00:46:04,020

an email group or or you know however

1316

00:46:06,829 --> 00:46:05,400

else you can think of the build

1317

00:46:09,109 --> 00:46:06,839

community

1318

00:46:10,069 --> 00:46:09,119

um it does it is taxing to start a

1319

00:46:14,750 --> 00:46:10,079

business

1320

00:46:17,569 --> 00:46:14,760

days are better than others in terms of

1321

00:46:19,490 --> 00:46:17,579

the anxiety in terms of the drudgery in

1322

00:46:21,589 --> 00:46:19,500

terms of the oh I see this form to file

1323

00:46:23,150 --> 00:46:21,599

and as a leader of business there's

1324

00:46:24,770 --> 00:46:23,160

nobody really you can

1325

00:46:26,690 --> 00:46:24,780

help you solve the problem but you have

1326

00:46:28,430 --> 00:46:26,700

to solve it yourself and that can be

1327

00:46:30,230 --> 00:46:28,440

emotionally draining as well

1328

00:46:32,210 --> 00:46:30,240

um however

1329

00:46:34,130 --> 00:46:32,220

if you're able to then take a step back

1330

00:46:35,809 --> 00:46:34,140

and see the bigger picture then that

1331

00:46:38,150 --> 00:46:35,819

provides all the motivation the reasons

1332

00:46:39,650 --> 00:46:38,160

why you do all this but think very

1333

00:46:41,089 --> 00:46:39,660

carefully before you start a business

1334

00:46:43,970 --> 00:46:41,099

that is something you want to do because

1335

00:46:46,849 --> 00:46:43,980

there's a lot a lot of work behind it

1336

00:46:48,470 --> 00:46:46,859

yeah indeed now one thing I do love

1337

00:46:50,569 --> 00:46:48,480

about our show

1338

00:46:52,250 --> 00:46:50,579

um in our audience q a we often have

1339

00:46:54,470 --> 00:46:52,260

questions that are very targeted towards

1340

00:46:56,809 --> 00:46:54,480

our guests sometimes we just have random

1341

00:46:59,089 --> 00:46:56,819

questions about astrobiology and so feel

1342

00:47:00,650 --> 00:46:59,099

free to say that you have no idea of the

1343

00:47:04,190 --> 00:47:00,660

answers for some of these questions but

1344

00:47:06,530 --> 00:47:04,200

uh user Laura Siana on YouTube

1345

00:47:09,050 --> 00:47:06,540

um wants to know if you think uh life is

1346

00:47:11,569 --> 00:47:09,060

possible on the night side of a tidally

1347

00:47:15,170 --> 00:47:11,579

lost planet around an m-class star if

1348

00:47:16,849 --> 00:47:15,180

it'd be protected from a stellar flare

1349

00:47:19,490 --> 00:47:16,859

if it's tightly locked on the night side

1350

00:47:20,510 --> 00:47:19,500

then there is no sunlight that gets

1351

00:47:23,270 --> 00:47:20,520

there

1352

00:47:26,150 --> 00:47:23,280

and I can't see how biology would

1353

00:47:29,329 --> 00:47:26,160

survive the cold or the lack of energy

1354

00:47:31,250 --> 00:47:29,339

so Never Say Never biology finds a way

1355

00:47:32,450 --> 00:47:31,260

but it's not the place I would look for

1356

00:47:34,550 --> 00:47:32,460

first

1357

00:47:35,990 --> 00:47:34,560

okay love it

1358

00:47:37,670 --> 00:47:36,000

um and then we do have to speed up a

1359

00:47:38,870 --> 00:47:37,680

little bit unfortunately I'm so sorry to

1360

00:47:40,730 --> 00:47:38,880

our audience thank you for all these

1361

00:47:42,890 --> 00:47:40,740

awesome questions I'm going to pick and

1362

00:47:45,109 --> 00:47:42,900

choose a couple of them here myself we

1363

00:47:46,849 --> 00:47:45,119

have one from

1364

00:47:50,510 --> 00:47:46,859

um the center for of astronomical

1365

00:47:52,790 --> 00:47:50,520

Research on Twitter at upgrade me bb1 a

1366

00:47:54,109 --> 00:47:52,800

great username uh can studying life at

1367

00:47:55,670 --> 00:47:54,119

extreme temperatures broaden our

1368

00:47:57,710 --> 00:47:55,680

understanding of possible life outside

1369

00:48:00,290 --> 00:47:57,720

of our defined Goldilocks zone or

1370

00:48:02,030 --> 00:48:00,300

habitable zone is it best to look or is

1371

00:48:03,950 --> 00:48:02,040

it best to look for life in Earth-like

1372

00:48:05,990 --> 00:48:03,960

exoplanets

1373

00:48:09,829 --> 00:48:06,000

yes I mean the Goldilocks zone just

1374

00:48:11,450 --> 00:48:09,839

means that water is liquid right and so

1375

00:48:13,010 --> 00:48:11,460

that doesn't tell you much about

1376

00:48:15,170 --> 00:48:13,020

anything else about biological

1377

00:48:17,750 --> 00:48:15,180

adaptation so understanding the extremes

1378

00:48:21,290 --> 00:48:17,760

of Life uh I think is fundamental to

1379

00:48:22,910 --> 00:48:21,300

understanding our ability to explore

1380

00:48:24,170 --> 00:48:22,920

locations that you wouldn't think about

1381

00:48:27,109 --> 00:48:24,180

first

1382

00:48:28,730 --> 00:48:27,119

um these really hot temperatures

1383

00:48:31,730 --> 00:48:28,740

um you wouldn't you know those are only

1384

00:48:34,430 --> 00:48:31,740

discovered in the 1970s like before we

1385

00:48:36,890 --> 00:48:34,440

saw we thought the sea floor was Barren

1386

00:48:39,050 --> 00:48:36,900

but no we discovered this new source of

1387

00:48:41,809 --> 00:48:39,060

energy and biology somehow is it I think

1388

00:48:44,150 --> 00:48:41,819

the record now is 122 degrees Celsius is

1389

00:48:47,150 --> 00:48:44,160

for the hottest thermophiles which is

1390

00:48:49,010 --> 00:48:47,160

crazy numbers right and so uh let's

1391

00:48:51,650 --> 00:48:49,020

explore this parameter space in terms of

1392

00:48:54,890 --> 00:48:51,660

not only temperature but salinity

1393

00:48:57,109 --> 00:48:54,900

um pH uh pressure you know and what in

1394

00:48:59,329 --> 00:48:57,119

that physical parameter space is biology

1395

00:49:01,730 --> 00:48:59,339

capable of because their environments

1396

00:49:03,950 --> 00:49:01,740

beyond Earth that are somewhere in that

1397

00:49:05,630 --> 00:49:03,960

parameter space and if we can establish

1398

00:49:08,450 --> 00:49:05,640

through scientific research that biology

1399

00:49:10,430 --> 00:49:08,460

is possible then that opens up the scope

1400

00:49:12,470 --> 00:49:10,440

of planets and environments that are

1401

00:49:16,309 --> 00:49:12,480

capable of Hosting life which is which

1402

00:49:17,569 --> 00:49:16,319

is which is fantastic fantastic

1403

00:49:18,890 --> 00:49:17,579

um as I said I'm going to skip through a

1404

00:49:21,410 --> 00:49:18,900

few questions here I have one from Terry

1405

00:49:22,849 --> 00:49:21,420

Trevino on YouTube uh Terry wants to

1406

00:49:24,890 --> 00:49:22,859

know how you think electromagnetism

1407

00:49:26,569 --> 00:49:24,900

might have been in part in kicking off

1408

00:49:28,550 --> 00:49:26,579

the electric Fields inside of cellular

1409

00:49:32,390 --> 00:49:28,560

structures

1410

00:49:34,250 --> 00:49:32,400

I have no idea love it

1411

00:49:35,270 --> 00:49:34,260

um yeah I'm not actually sure either

1412

00:49:37,790 --> 00:49:35,280

um you know there's there's

1413

00:49:39,589 --> 00:49:37,800

electromagnetism you know it's kind of

1414

00:49:41,750 --> 00:49:39,599

inherent in a lot of the the conduction

1415

00:49:44,809 --> 00:49:41,760

of electricity it'll create a magnetic

1416

00:49:47,150 --> 00:49:44,819

field so it's worth looking into more

1417

00:49:48,770 --> 00:49:47,160

um how about so user Holden Faraday asks

1418

00:49:51,970 --> 00:49:48,780

what is more likely to have Signs of

1419

00:49:55,069 --> 00:49:51,980

Life Enceladus or Titan

1420

00:49:58,790 --> 00:49:55,079

Enceladus or Titan

1421

00:50:00,410 --> 00:49:58,800

um okay it has a two different worlds

1422

00:50:01,730 --> 00:50:00,420

that are explored with different

1423

00:50:05,809 --> 00:50:01,740

spacecraft

1424

00:50:09,890 --> 00:50:05,819

um so Enceladus we can probe the uh

1425

00:50:13,430 --> 00:50:09,900

exhaust from the the geysers whereas on

1426  
00:50:17,150 --> 00:50:13,440  
Titan we will land on a very cold planet

1427  
00:50:19,190 --> 00:50:17,160  
with liquid methane as a main cycle of

1428  
00:50:20,390 --> 00:50:19,200  
of liquid

1429  
00:50:22,250 --> 00:50:20,400  
um

1430  
00:50:23,930 --> 00:50:22,260  
gosh those are such two different worlds

1431  
00:50:25,490 --> 00:50:23,940  
I would still lean towards and sell this

1432  
00:50:27,309 --> 00:50:25,500  
become biased towards my water Rock

1433  
00:50:30,710 --> 00:50:27,319  
systems as providing energy

1434  
00:50:33,650 --> 00:50:30,720  
I don't see life being comfortable in

1435  
00:50:36,589 --> 00:50:33,660  
the cold temperatures of Titan on the

1436  
00:50:38,569 --> 00:50:36,599  
surface at least in in the methane or

1437  
00:50:39,589 --> 00:50:38,579  
ethane Lakes I think that's that's not a

1438  
00:50:41,990 --> 00:50:39,599

good solvent

1439

00:50:43,490 --> 00:50:42,000

um very exciting place to explore of

1440

00:50:45,290 --> 00:50:43,500

course and of course we should look for

1441

00:50:46,670 --> 00:50:45,300

biology there because it's such an

1442

00:50:48,109 --> 00:50:46,680

important question to answer whether

1443

00:50:50,690 --> 00:50:48,119

like whether or not we're alone in the

1444

00:50:52,670 --> 00:50:50,700

universe but I'm still leaning towards

1445

00:50:54,770 --> 00:50:52,680

the ocean worlds uh the traditional ones

1446

00:50:57,349 --> 00:50:54,780

of Europa and Enceladus a good question

1447

00:50:59,210 --> 00:50:57,359

I appreciate it yeah it's a very

1448

00:51:02,210 --> 00:50:59,220

interesting one for sure

1449

00:51:04,490 --> 00:51:02,220

um user PIAA asks uh what do you think

1450

00:51:05,690 --> 00:51:04,500

about the term alien uh they say it

1451

00:51:07,970 --> 00:51:05,700

seems to me it's a very loaded term

1452

00:51:09,109 --> 00:51:07,980

especially in this day and age uh so for

1453

00:51:10,309 --> 00:51:09,119

you sanjoy what do you think of the word

1454

00:51:12,410 --> 00:51:10,319

alien

1455

00:51:13,910 --> 00:51:12,420

uh depends on its usage I agree the

1456

00:51:15,349 --> 00:51:13,920

reason why it's loaded I mean I'm an

1457

00:51:16,970 --> 00:51:15,359

immigrant to the United States and I was

1458

00:51:17,990 --> 00:51:16,980

considered a non-resident alien for a

1459

00:51:20,450 --> 00:51:18,000

long time and it was a little weird

1460

00:51:21,290 --> 00:51:20,460

because as an astrobiologist well you

1461

00:51:22,790 --> 00:51:21,300

know it has a little bit different

1462

00:51:24,829 --> 00:51:22,800

definition

1463

00:51:28,069 --> 00:51:24,839

um and so

1464

00:51:31,069 --> 00:51:28,079

you know like it's it's

1465

00:51:33,890 --> 00:51:31,079

the usage of words to classify people

1466

00:51:34,910 --> 00:51:33,900

will offend someone somewhere

1467

00:51:36,770 --> 00:51:34,920

um

1468

00:51:39,049 --> 00:51:36,780

so but you also have to use those words

1469

00:51:42,470 --> 00:51:39,059

to express yourself and so just be

1470

00:51:44,569 --> 00:51:42,480

conscious that sometimes people might be

1471

00:51:46,309 --> 00:51:44,579

offended and if they are learn why and

1472

00:51:48,470 --> 00:51:46,319

that can affect the way but it's

1473

00:51:50,510 --> 00:51:48,480

impossible to

1474

00:51:52,490 --> 00:51:50,520

preemptively find a word that everybody

1475

00:51:54,290 --> 00:51:52,500

will be happy with just because we're

1476

00:51:56,450 --> 00:51:54,300

all living in our own little world that

1477

00:51:58,970 --> 00:51:56,460

we're not necessarily exposed to the

1478

00:52:01,849 --> 00:51:58,980

cultures or other ways of thinking that

1479

00:52:03,230 --> 00:52:01,859

might feel threatened by the use of the

1480

00:52:05,930 --> 00:52:03,240

word alien or any other word that

1481

00:52:08,329 --> 00:52:05,940

describes the population so if you find

1482

00:52:11,270 --> 00:52:08,339

yourself being criticized by a you know

1483

00:52:12,710 --> 00:52:11,280

learn why and maybe that changes the way

1484

00:52:15,109 --> 00:52:12,720

you express yourself

1485

00:52:16,549 --> 00:52:15,119

um but it's just the world we live in

1486

00:52:18,049 --> 00:52:16,559

today seems to be very sensitive with

1487

00:52:20,030 --> 00:52:18,059

all these different terms and and for

1488

00:52:22,130 --> 00:52:20,040

good reasons as we're more and more

1489

00:52:24,650 --> 00:52:22,140

aware of the historical baggage that

1490

00:52:27,170 --> 00:52:24,660

some of those terms use but the word

1491

00:52:28,609 --> 00:52:27,180

alien is is doesn't bother me as much as

1492

00:52:29,150 --> 00:52:28,619

others

1493

00:52:31,190 --> 00:52:29,160

um

1494

00:52:32,630 --> 00:52:31,200

awesome uh thank you so much for all of

1495

00:52:33,710 --> 00:52:32,640

your answers here to our audience who

1496

00:52:35,150 --> 00:52:33,720

are watching

1497

00:52:37,069 --> 00:52:35,160

um there are so many more questions I'm

1498

00:52:38,390 --> 00:52:37,079

sorry we could not get to the mall

1499

00:52:39,589 --> 00:52:38,400

um we did have a slightly late start in

1500

00:52:41,030 --> 00:52:39,599

this episode

1501  
00:52:42,890 --> 00:52:41,040  
um but thank you so much if you do want

1502  
00:52:44,410 --> 00:52:42,900  
to ask your questions of sanjoy or

1503  
00:52:47,210 --> 00:52:44,420  
myself you can find us both on Twitter

1504  
00:52:50,030 --> 00:52:47,220  
sanjoy is at sanjoy Marcel on Twitter

1505  
00:52:52,970 --> 00:52:50,040  
I'm at cosmobiologists you can also find

1506  
00:52:57,170 --> 00:52:52,980  
the NASA astrobiology program at NASA

1507  
00:52:59,089 --> 00:52:57,180  
astrobio or Sega net at sega.org on

1508  
00:53:00,230 --> 00:52:59,099  
Twitter you can also search for sanjoy

1509  
00:53:01,370 --> 00:53:00,240  
online you'll find a lot of great hits

1510  
00:53:03,950 --> 00:53:01,380  
about him there's a really awesome

1511  
00:53:06,109 --> 00:53:03,960  
interview article from NASA that they

1512  
00:53:07,250 --> 00:53:06,119  
did on sanjoy fairly recently

1513  
00:53:08,809 --> 00:53:07,260

um I do want to close it out just a

1514

00:53:12,170 --> 00:53:08,819

little bit coming back to this idea of

1515

00:53:13,970 --> 00:53:12,180

the one flag emblem in space

1516

00:53:16,250 --> 00:53:13,980

um you've written two papers over the

1517

00:53:18,710 --> 00:53:16,260

years kind of around this idea you've

1518

00:53:20,569 --> 00:53:18,720

had about community and kind of you know

1519

00:53:23,329 --> 00:53:20,579

building this idea of our identity

1520

00:53:24,650 --> 00:53:23,339

together in space you had one paper that

1521

00:53:25,910 --> 00:53:24,660

was called an international symbol for

1522

00:53:28,190 --> 00:53:25,920

the sustained exploration of space

1523

00:53:30,170 --> 00:53:28,200

talking about this idea of having one

1524

00:53:32,270 --> 00:53:30,180

one symbol together you had a more

1525

00:53:35,270 --> 00:53:32,280

recent paper called common identity as a

1526

00:53:36,950 --> 00:53:35,280

step to civilization longevity I wonder

1527

00:53:39,470 --> 00:53:36,960

if you can speak kind of to your vision

1528

00:53:41,630 --> 00:53:39,480

of finding that common identity together

1529

00:53:43,309 --> 00:53:41,640

and will there be a third paper that

1530

00:53:46,010 --> 00:53:43,319

kind of culminates any of this stuff

1531

00:53:50,270 --> 00:53:46,020

these ideas of of having all of us kind

1532

00:53:54,410 --> 00:53:52,010

it's hard to do it in in short time but

1533

00:53:57,290 --> 00:53:54,420

the one thing I can say is that the

1534

00:53:59,750 --> 00:53:57,300

beauty in humanity lies in its diversity

1535

00:54:01,970 --> 00:53:59,760

we learn so much more about ourselves

1536

00:54:03,530 --> 00:54:01,980

about The Way We Believe by taking the

1537

00:54:05,270 --> 00:54:03,540

time to engage with people who don't

1538

00:54:07,670 --> 00:54:05,280

think like us believe like us or look

1539

00:54:09,589 --> 00:54:07,680

like us and thinking as ourselves as

1540

00:54:11,150 --> 00:54:09,599

humans first and foremost provides the

1541

00:54:12,770 --> 00:54:11,160

opportunity to start that conversation

1542

00:54:14,750 --> 00:54:12,780

right you need something in common

1543

00:54:16,130 --> 00:54:14,760

usually to start a conversation with

1544

00:54:18,589 --> 00:54:16,140

somebody that's very different than you

1545

00:54:19,970 --> 00:54:18,599

and sometimes that's the barrier like I

1546

00:54:21,530 --> 00:54:19,980

don't know what we have in common or

1547

00:54:23,329 --> 00:54:21,540

know how to start a conversation but

1548

00:54:25,130 --> 00:54:23,339

like hey look at the Earth what do you

1549

00:54:27,410 --> 00:54:25,140

think you know that's like we both can

1550

00:54:28,849 --> 00:54:27,420

relate so it's a conversation starter so

1551

00:54:30,770 --> 00:54:28,859

the first paper is really emphasizing

1552

00:54:33,170 --> 00:54:30,780

the fact that we are humans first and

1553

00:54:35,030 --> 00:54:33,180

foremost second paper is really

1554

00:54:37,670 --> 00:54:35,040

um emphasizing that this diversity is

1555

00:54:40,609 --> 00:54:37,680

really important in in improving who we

1556

00:54:42,710 --> 00:54:40,619

are as humans and I'm not sure where the

1557

00:54:44,210 --> 00:54:42,720

third one will go but I mean as I

1558

00:54:46,910 --> 00:54:44,220

learned to engage with people that are

1559

00:54:49,430 --> 00:54:46,920

not like me I get new ideas on how we

1560

00:54:51,650 --> 00:54:49,440

can come together as a society which is

1561

00:54:54,230 --> 00:54:51,660

really really important because of all

1562

00:54:56,690 --> 00:54:54,240

the challenges we Face environmentally

1563

00:54:58,970 --> 00:54:56,700

and geopolitically

1564

00:55:00,710 --> 00:54:58,980

that's wonderful we are going to close

1565

00:55:02,690 --> 00:55:00,720

out the show now I do want to say sanjoy

1566

00:55:04,549 --> 00:55:02,700

a special thank you to you for joining

1567

00:55:07,609 --> 00:55:04,559

us here for ask an astrobiologist you've

1568

00:55:08,750 --> 00:55:07,619

been a great friend a mentor a boss over

1569

00:55:10,670 --> 00:55:08,760

the years

1570

00:55:12,290 --> 00:55:10,680

um I'm so honored and thrilled to be

1571

00:55:13,970 --> 00:55:12,300

part of Blue Marble space and Sega net

1572

00:55:15,470 --> 00:55:13,980

and to be part of this show and really

1573

00:55:16,549 --> 00:55:15,480

it's because of you and the vision that

1574

00:55:17,930 --> 00:55:16,559

you've had

1575

00:55:20,750 --> 00:55:17,940

um and bringing me and so many of us

1576

00:55:22,370 --> 00:55:20,760

together and allowing us to explore our

1577

00:55:25,730 --> 00:55:22,380

diversity and our different opinions and

1578

00:55:27,589 --> 00:55:25,740

ideas together as an organization

1579

00:55:28,970 --> 00:55:27,599

um you know you've done so much for for

1580

00:55:30,170 --> 00:55:28,980

young people around the world to bring

1581

00:55:31,309 --> 00:55:30,180

them into this and for our audience

1582

00:55:33,349 --> 00:55:31,319

watching I know there's a lot of

1583

00:55:34,970 --> 00:55:33,359

undergraduate and graduate students from

1584

00:55:38,690 --> 00:55:34,980

around the world who are watching right

1585

00:55:40,190 --> 00:55:38,700

now who want to be part of this journey

1586

00:55:42,829 --> 00:55:40,200

um so if you do want to keep up with

1587

00:55:44,750 --> 00:55:42,839

what we're doing in NASA astrobiology uh

1588

00:55:46,730 --> 00:55:44,760

you can use the QR code popping up on

1589

00:55:49,790 --> 00:55:46,740

the screen right now to sign up for the

1590

00:55:51,650 --> 00:55:49,800

NASA astrobiology mailing list of course

1591

00:55:54,730 --> 00:55:51,660

you can find more information about Blue

1592

00:55:58,670 --> 00:55:54,740

Marble space and bmsis at

1593

00:56:00,230 --> 00:55:58,680

bluemarlespace.org or at BMS is.org it's

1594

00:56:02,150 --> 00:56:00,240

always fun to hear from all of you who

1595

00:56:04,130 --> 00:56:02,160

watch the show and again if you do want

1596

00:56:06,109 --> 00:56:04,140

to ask more of your questions of any of

1597

00:56:07,549 --> 00:56:06,119

us you can find us all online in many

1598

00:56:09,290 --> 00:56:07,559

places

1599

00:56:11,329 --> 00:56:09,300

um and sanjoy I actually have one small

1600

00:56:13,609 --> 00:56:11,339

request

1601  
00:56:15,589 --> 00:56:13,619  
um so when you first started closing out

1602  
00:56:17,450 --> 00:56:15,599  
the show for ask an astrobiologist you'd

1603  
00:56:19,730 --> 00:56:17,460  
always say until next time stay curious

1604  
00:56:22,309 --> 00:56:19,740  
and I stole that from you and I've been

1605  
00:56:24,650 --> 00:56:22,319  
doing it for a long time I wonder since

1606  
00:56:26,150 --> 00:56:24,660  
we have you back would you mind closing

1607  
00:56:28,069 --> 00:56:26,160  
us out

1608  
00:56:29,569 --> 00:56:28,079  
thank you so much for asking oh my gosh

1609  
00:56:31,309 --> 00:56:29,579  
it's fantastic friends it's been an

1610  
00:56:33,170 --> 00:56:31,319  
incredible episode please don't forget

1611  
00:56:38,550 --> 00:56:33,180  
to catch us next time on ask us

1612  
00:56:55,850 --> 00:56:43,809  
[Music]

1613  
00:56:56,700 --> 00:56:55,860

[Applause]

1614

00:56:58,600 --> 00:56:56,710

[Music]

1615

00:57:07,750 --> 00:56:58,610

[Applause]