






Attendees (40)

▼ Hosts (3)

-  Estelle Dodson
-  Marco Boldt
-  Mike Toillion

▼ Presenters (9)

-  Andy Burnett
-  Chris House
-  Kelsi Singer
-  Michael New
-  Shawn Domagal-G...
-  stavros
-  tim morley
-  Tori Hoehler
-  Victoria Meadows

▼ Participants (28)

-  Bob Pappalardo
-  Britney Schmidt
-  Bruner
-  Christopher E. Carr
-  Cynthia Dinwiddie
-  Dionysis Foustouk...
-  Erik Fischer

Open Chat (Everyone)

----- (05/06/2013 10:48) -----
 Marika Tarasashvili: Okay, I think I am online
 Marika Tarasashvili: I can here y :) O.K.ou
 Marika Tarasashvili: hear
 Marika Tarasashvili: :)))
 ----- (05/06/2013 10:54) -----
 Wayne Nicholson @ U. Florida: Hey Mike,
 good to see you again.
 ----- (05/06/2013 11:00) -----
 stavros: Good day everyone. I will be
 monitoring the chat on behalf of the panel.
 It is nice to meet everyone.
 Gal Sarid: Nice to meet you too :)
 Marika Tarasashvili: Nice to meet you!
 ----- (05/06/2013 11:02) -----
 Estelle Dodson: hi all, welcome
 ----- (05/06/2013 11:03) -----
 Lev Horodyskyj (ASU): is there any sound
 yet?
 Mike Toillion: Yes, please dial into the
 telecon below for sound.
 Lev Horodyskyj (ASU): ok, thanks
 ----- (05/06/2013 11:08) -----
 Mike Toillion: As a reminder, when not
 speaking, please use * 6 to mute your phone's
 microphone. When you wish to speak, push *
 6 again to unmute. Thanks!
 Estelle Dodson is typing..

Live Notes

Solar System Exploration Panel.pptx

Full Screen



Agenda

- Welcome & Opening Remarks
- Overview of Today's Agenda
- Panelist Introductions
- Moderated Panel Discussion
- Open Q&A
- Next Steps

1
00:00:14,150 --> 00:00:10,549
good morning good afternoon to everyone

2
00:00:17,269 --> 00:00:14,160
wherever you may be i'm andy burnett um

3
00:00:20,070 --> 00:00:17,279
i am one of the organizers for this

4
00:00:21,750 --> 00:00:20,080
overall road mapping event and i have a

5
00:00:23,750 --> 00:00:21,760
couple of colleagues with me

6
00:00:26,310 --> 00:00:23,760
stavros i suppose actually just pointing

7
00:00:29,429 --> 00:00:26,320
from my end doesn't really help and uh

8
00:00:31,669 --> 00:00:29,439
to my left my colleague tim morley um

9
00:00:34,389 --> 00:00:31,679
and hopefully we'll be meeting many of

10
00:00:38,630 --> 00:00:34,399
you when we come to the face-to-face

11
00:00:40,709 --> 00:00:38,640
uh workshop on this now in the intro um

12
00:00:43,750 --> 00:00:40,719
for the technical overview mike did

13
00:00:46,229 --> 00:00:43,760

mention that we're recording everything

14

00:00:49,430 --> 00:00:46,239

but just in case anyone joined just

15

00:00:50,950 --> 00:00:49,440

after he he'd said that um for full

16

00:00:53,270 --> 00:00:50,960

disclosure all we're doing is we're

17

00:00:55,350 --> 00:00:53,280

recording these sessions and we'll put

18

00:00:56,869 --> 00:00:55,360

them up there's a youtube

19

00:00:59,189 --> 00:00:56,879

channel and

20

00:01:01,270 --> 00:00:59,199

so everything that we say in the chat

21

00:01:03,750 --> 00:01:01,280

window or that uh that anyone talks

22

00:01:07,030 --> 00:01:03,760

about participants and presenters will

23

00:01:07,830 --> 00:01:07,040

be available on the uh on the internet

24

00:01:10,230 --> 00:01:07,840

now

25

00:01:13,270 --> 00:01:10,240

this is the first of a series of

26
00:01:14,630 --> 00:01:13,280
webinars which are designed to build up

27
00:01:17,190 --> 00:01:14,640
um

28
00:01:19,990 --> 00:01:17,200
our collective understanding on the

29
00:01:23,350 --> 00:01:20,000
topics which will then apply in the road

30
00:01:24,789 --> 00:01:23,360
mapping workshop um and our hope is that

31
00:01:26,870 --> 00:01:24,799
workshop will involve people

32
00:01:28,390 --> 00:01:26,880
participating both physically and

33
00:01:29,749 --> 00:01:28,400
virtually so

34
00:01:32,630 --> 00:01:29,759
i think it's important to recognize that

35
00:01:33,830 --> 00:01:32,640
this is a an ongoing process but these

36
00:01:36,390 --> 00:01:33,840
uh first

37
00:01:38,069 --> 00:01:36,400
webinars are very important parts of the

38
00:01:41,670 --> 00:01:38,079

input for that

39

00:01:43,510 --> 00:01:41,680

so we have um assembled a panel to give

40

00:01:46,069 --> 00:01:43,520

us provocative thoughts we have the

41

00:01:48,950 --> 00:01:46,079

opportunity to do q a during this

42

00:01:52,109 --> 00:01:48,960

webinar and there is if you are not

43

00:01:54,230 --> 00:01:52,119

aware of it already there is a website

44

00:01:56,310 --> 00:01:54,240

astrobiologyfuture.org we encourage

45

00:01:58,789 --> 00:01:56,320

everyone to register there we will be

46

00:02:00,630 --> 00:01:58,799

holding discussions on that following

47

00:02:01,510 --> 00:02:00,640

each of the webinars

48

00:02:03,830 --> 00:02:01,520

and

49

00:02:06,149 --> 00:02:03,840

we'll then be taking the input from that

50

00:02:09,910 --> 00:02:06,159

and that forms part of the input for the

51
00:02:11,589 --> 00:02:09,920
roadmapping workshop um now i see i've

52
00:02:12,390 --> 00:02:11,599
got sean

53
00:02:14,790 --> 00:02:12,400
in

54
00:02:16,790 --> 00:02:14,800
the group here i don't have michael sean

55
00:02:20,309 --> 00:02:16,800
at this point let me just ask is there

56
00:02:22,710 --> 00:02:20,319
anything that you want to add and i'm

57
00:02:23,990 --> 00:02:22,720
hoping that you have the ability

58
00:02:27,350 --> 00:02:24,000
to talk because i see you're in the

59
00:02:28,630 --> 00:02:27,360
participants list

60
00:02:32,150 --> 00:02:28,640
so

61
00:02:35,350 --> 00:02:32,160
if i have just silence of the oh hang on

62
00:02:38,309 --> 00:02:35,360
hello excuse my ignorance hey

63
00:02:41,750 --> 00:02:38,319

um is there anything that you want to

64

00:02:43,190 --> 00:02:41,760

add by way of intro for the participants

65

00:02:44,869 --> 00:02:43,200

on this

66

00:02:46,630 --> 00:02:44,879

uh i would i think i would just

67

00:02:48,630 --> 00:02:46,640

echo thanks to everyone that's going to

68

00:02:50,309 --> 00:02:48,640

participate because we we really value

69

00:02:51,350 --> 00:02:50,319

this activity and think it's important

70

00:02:53,030 --> 00:02:51,360

to

71

00:02:54,790 --> 00:02:53,040

get as much community involvement as

72

00:02:56,710 --> 00:02:54,800

possible and setting a future course for

73

00:03:00,229 --> 00:02:56,720

the field and for all of these different

74

00:03:04,229 --> 00:03:01,270

brilliant

75

00:03:06,869 --> 00:03:04,239

all right thanks very much um

76

00:03:09,030 --> 00:03:06,879

let me start then by just asking the

77

00:03:11,350 --> 00:03:09,040

panelists to introduce themselves

78

00:03:13,990 --> 00:03:11,360

briefly and i'll start on my left

79

00:03:18,070 --> 00:03:16,550

hi so i'm victoria meadows i'm the

80

00:03:19,589 --> 00:03:18,080

principal investigator for the nasa

81

00:03:21,589 --> 00:03:19,599

astrobiology institute's virtual

82

00:03:23,190 --> 00:03:21,599

planetary laboratory i'm also the

83

00:03:25,350 --> 00:03:23,200

director for the astrobiology graduate

84

00:03:27,110 --> 00:03:25,360

program here at university of washington

85

00:03:28,869 --> 00:03:27,120

and i was trained as a planetary

86

00:03:30,229 --> 00:03:28,879

astronomer and i'm very interested in

87

00:03:32,630 --> 00:03:30,239

questions of extrasolar planet

88

00:03:34,070 --> 00:03:32,640

habitability

89

00:03:35,670 --> 00:03:34,080

cool

90

00:03:40,869 --> 00:03:35,680

tori

91

00:03:42,949 --> 00:03:40,879

i am a chemist by background and and

92

00:03:45,030 --> 00:03:42,959

then have training in oceanography

93

00:03:46,710 --> 00:03:45,040

i work now mostly in microsoft

94

00:03:48,550 --> 00:03:46,720

ecosystems but always with an eye toward

95

00:03:50,550 --> 00:03:48,560

better understanding

96

00:03:54,470 --> 00:03:50,560

what habitability is and how organisms

97

00:03:54,480 --> 00:03:58,149

excellent chris

98

00:04:02,550 --> 00:04:00,630

i'm chris house i'm a professor of

99

00:04:03,990 --> 00:04:02,560

geosciences at penn state i'm also the

100

00:04:05,270 --> 00:04:04,000

director for the penn state astrobiology

101
00:04:07,589 --> 00:04:05,280
research center

102
00:04:09,830 --> 00:04:07,599
my background is degrees is in

103
00:04:12,949 --> 00:04:09,840
biochemistry and in geology

104
00:04:15,509 --> 00:04:12,959
and my interest

105
00:04:17,270 --> 00:04:15,519
uh microbial life in unusual places its

106
00:04:20,710 --> 00:04:17,280
metabolism and the signatures that it

107
00:04:24,230 --> 00:04:21,749
thank you

108
00:04:25,189 --> 00:04:24,240
and kelsey

109
00:04:28,629 --> 00:04:25,199
hi

110
00:04:31,270 --> 00:04:28,639
university in st louis and i just

111
00:04:33,590 --> 00:04:31,280
completed my phd studying the itunes

112
00:04:35,510 --> 00:04:33,600
wounds of jupiter and saturn and i'm

113
00:04:37,030 --> 00:04:35,520

going to be starting a postdoc

114

00:04:38,390 --> 00:04:37,040

looking at earth's moons a little bit

115

00:04:40,469 --> 00:04:38,400

closer to home

116

00:04:42,870 --> 00:04:40,479

and what i do is currently do is

117

00:04:47,110 --> 00:04:42,880

consider geology and geophysics

118

00:04:51,030 --> 00:04:49,590

excellent okay thank you very much

119

00:04:54,150 --> 00:04:51,040

um now

120

00:04:56,710 --> 00:04:54,160

mike at this point i'm just going to ask

121

00:05:00,710 --> 00:04:56,720

we had a slide pack

122

00:05:00,720 --> 00:05:05,670

it's amazing isn't it power of the mind

123

00:05:09,110 --> 00:05:07,270

and uh to change slides and use the

124

00:05:11,590 --> 00:05:09,120

arrow icons at the bottom of that share

125

00:05:13,510 --> 00:05:11,600

pod gotcha thank you

126

00:05:16,310 --> 00:05:13,520

and just to remind folks we we do have a

127

00:05:18,310 --> 00:05:16,320

few open mics if you can press pound uh

128

00:05:19,909 --> 00:05:18,320

sorry star six that will mute your

129

00:05:21,909 --> 00:05:19,919

microphone and then we won't hear as

130

00:05:25,670 --> 00:05:21,919

much of the background static some of

131

00:05:27,350 --> 00:05:25,680

you might be hearing now thanks

132

00:05:28,390 --> 00:05:27,360

fantastic thank you

133

00:05:29,830 --> 00:05:28,400

um

134

00:05:31,590 --> 00:05:29,840

okay

135

00:05:32,950 --> 00:05:31,600

when i first saw this slide which was

136

00:05:35,110 --> 00:05:32,960

put together i call it what i have to

137

00:05:37,350 --> 00:05:35,120

admit every time i um

138

00:05:39,270 --> 00:05:37,360

when i see the telescopes it just

139

00:05:41,909 --> 00:05:39,280

distracts me from whatever it says next

140

00:05:43,670 --> 00:05:41,919

to it so just focusing on the words for

141

00:05:46,070 --> 00:05:43,680

a moment

142

00:05:48,870 --> 00:05:46,080

done opens welcoming the agenda for

143

00:05:51,510 --> 00:05:48,880

today is fairly straightforward uh as

144

00:05:54,469 --> 00:05:51,520

i've already outlined so what i wanted

145

00:05:57,590 --> 00:05:54,479

to do i'm going to skip over

146

00:05:59,830 --> 00:05:57,600

this slide i wanted to move to what

147

00:06:01,029 --> 00:05:59,840

we've actually asked the panelists to

148

00:06:03,430 --> 00:06:01,039

talk about

149

00:06:05,749 --> 00:06:03,440

and the format we'd like to use is

150

00:06:09,270 --> 00:06:05,759

really just to invite whoever wants to

151

00:06:10,950 --> 00:06:09,280

go first on this michael hello

152

00:06:13,510 --> 00:06:10,960

um

153

00:06:16,870 --> 00:06:13,520

to to kick us off with our first

154

00:06:19,510 --> 00:06:16,880

question um with regards to astrobiology

155

00:06:21,990 --> 00:06:19,520

for the non-scientists so we're not

156

00:06:23,990 --> 00:06:22,000

looking for rather stilted responses

157

00:06:26,309 --> 00:06:24,000

from everyone we want to get the

158

00:06:28,790 --> 00:06:26,319

thoughts whoever wants to go first how

159

00:06:30,790 --> 00:06:28,800

do you go about tackling this and my

160

00:06:33,270 --> 00:06:30,800

colleague stavros is going to monitor

161

00:06:34,550 --> 00:06:33,280

our chat window as well and so every so

162

00:06:37,510 --> 00:06:34,560

often we might

163

00:06:44,629 --> 00:06:37,520

poke people with another question

164

00:06:49,110 --> 00:06:47,430

all right i guess i'll jump in

165

00:06:51,189 --> 00:06:49,120

starting with the first one uh how would

166

00:06:52,390 --> 00:06:51,199

i describe astrobiology for solar system

167

00:06:54,150 --> 00:06:52,400

exploration

168

00:06:56,150 --> 00:06:54,160

to a non-scientist i guess i would say

169

00:06:58,070 --> 00:06:56,160

that um you know there are there are

170

00:07:00,710 --> 00:06:58,080

both theoretical and

171

00:07:03,749 --> 00:07:00,720

practical concrete aspects to what we do

172

00:07:05,670 --> 00:07:03,759

in astrobiology uh and and when it comes

173

00:07:07,589 --> 00:07:05,680

time to actually go looking when it

174

00:07:09,189 --> 00:07:07,599

comes time to mount a search you have to

175

00:07:11,589 --> 00:07:09,199

settle on some

176

00:07:13,350 --> 00:07:11,599

uh concrete specifics that you use to

177

00:07:15,589 --> 00:07:13,360

parameterize whatever tools you're

178

00:07:18,070 --> 00:07:15,599

you're observing with uh or decide where

179

00:07:19,270 --> 00:07:18,080

to where to observe to begin with and

180

00:07:21,430 --> 00:07:19,280

there's a certain amount that can be

181

00:07:23,029 --> 00:07:21,440

done here at home by examining

182

00:07:25,029 --> 00:07:23,039

ecosystems that we have right here

183

00:07:26,629 --> 00:07:25,039

understanding life and its more general

184

00:07:27,990 --> 00:07:26,639

aspects

185

00:07:29,589 --> 00:07:28,000

that can take you some distance along

186

00:07:31,990 --> 00:07:29,599

the way to deciding what those concrete

187

00:07:33,270 --> 00:07:32,000

specifics should be and so in my mind at

188

00:07:35,990 --> 00:07:33,280

least

189

00:07:36,950 --> 00:07:36,000

this particular part of the discussion

190

00:07:40,710 --> 00:07:36,960

um

191

00:07:42,070 --> 00:07:40,720

relates to uh to how do you

192

00:07:44,309 --> 00:07:42,080

you know how do you study and understand

193

00:07:50,070 --> 00:07:44,319

systems here on earth in order to better

194

00:07:50,080 --> 00:07:55,670

other thoughts

195

00:07:55,680 --> 00:07:59,189

i can't share something

196

00:08:03,670 --> 00:08:01,990

okay uh yeah so i also kind of thought

197

00:08:05,270 --> 00:08:03,680

we might have similar answers to this

198

00:08:07,670 --> 00:08:05,280

question but um

199

00:08:09,830 --> 00:08:07,680

i guess i just wanted to emphasize that

200

00:08:11,909 --> 00:08:09,840

at least for me um the interdisciplinary

201
00:08:14,710 --> 00:08:11,919
nature how we can't answer these

202
00:08:17,749 --> 00:08:14,720
questions about life without having all

203
00:08:18,629 --> 00:08:17,759
these uh different fields come together

204
00:08:20,950 --> 00:08:18,639
um

205
00:08:22,390 --> 00:08:20,960
and so you know besides just being a big

206
00:08:25,510 --> 00:08:22,400
umbrella term

207
00:08:27,350 --> 00:08:25,520
for all this research that can relate to

208
00:08:28,469 --> 00:08:27,360
life in the universe which is a very big

209
00:08:30,390 --> 00:08:28,479
topic

210
00:08:31,990 --> 00:08:30,400
i like the fact that it's really like we

211
00:08:33,829 --> 00:08:32,000
have to come together to be able to do

212
00:08:37,589 --> 00:08:33,839
this we couldn't do it in our individual

213
00:08:42,070 --> 00:08:39,670

chris

214

00:08:44,149 --> 00:08:42,080

yeah i mean i agree with both tori and

215

00:08:46,389 --> 00:08:44,159

kelsey i want to just

216

00:08:48,710 --> 00:08:46,399

i guess add that that this is one of the

217

00:08:51,110 --> 00:08:48,720

central questions in astrobiology is to

218

00:08:52,790 --> 00:08:51,120

ultimately take the knowledge and

219

00:08:54,550 --> 00:08:52,800

go out and search

220

00:08:56,949 --> 00:08:54,560

um and so we need

221

00:08:59,030 --> 00:08:56,959

both time-tested approaches and some

222

00:09:00,710 --> 00:08:59,040

out-of-the-box approaches in order to

223

00:09:02,389 --> 00:09:00,720

get time-tested approaches you have to

224

00:09:03,910 --> 00:09:02,399

use those approaches here on earth and

225

00:09:06,150 --> 00:09:03,920

in different environments past and

226

00:09:07,990 --> 00:09:06,160

present and to get out of the box sort

227

00:09:09,829 --> 00:09:08,000

of approaches you also need to spend

228

00:09:11,750 --> 00:09:09,839

some effort and some time and

229

00:09:14,230 --> 00:09:11,760

looking at ecosystems and environments

230

00:09:18,550 --> 00:09:14,240

and unusual environments as well as

231

00:09:22,630 --> 00:09:20,230

victoria do you want around nothing on

232

00:09:24,630 --> 00:09:22,640

that um yeah yeah so i agree i mean one

233

00:09:26,790 --> 00:09:24,640

of the major components of this theme is

234

00:09:28,550 --> 00:09:26,800

is sort of taking what we can learn from

235

00:09:29,750 --> 00:09:28,560

earth life and environments to try and

236

00:09:31,110 --> 00:09:29,760

understand potentially habitable

237

00:09:32,949 --> 00:09:31,120

environments you know that might exist

238

00:09:35,509 --> 00:09:32,959

on solar system planets and satellites

239

00:09:36,949 --> 00:09:35,519

and extrasolar planets um but also i

240

00:09:39,590 --> 00:09:36,959

believe part of this theme is also

241

00:09:41,509 --> 00:09:39,600

looking at biosignatures and and part of

242

00:09:43,269 --> 00:09:41,519

that is is looking at sort of the effect

243

00:09:44,790 --> 00:09:43,279

that life has on its environment on this

244

00:09:46,630 --> 00:09:44,800

planet here where we have you know the

245

00:09:48,470 --> 00:09:46,640

only example of a known

246

00:09:50,470 --> 00:09:48,480

inhabited planet at the moment and

247

00:09:51,990 --> 00:09:50,480

determining how those effects might be

248

00:09:53,990 --> 00:09:52,000

different for different environments

249

00:09:56,550 --> 00:09:54,000

sort of for for more non-earth-like or

250

00:09:58,310 --> 00:09:56,560

non-earth type environments um so for

251

00:09:59,829 --> 00:09:58,320

example i sort of think of you know

252

00:10:02,150 --> 00:09:59,839

based on what i can learn about earth

253

00:10:04,310 --> 00:10:02,160

buyer signatures what might i be looking

254

00:10:05,670 --> 00:10:04,320

for on extrasolar planets that have say

255

00:10:10,710 --> 00:10:05,680

a different composition or a different

256

00:10:15,670 --> 00:10:13,990

for for the non-scientists

257

00:10:18,710 --> 00:10:15,680

what is it that's fundamentally

258

00:10:20,150 --> 00:10:18,720

different about astrobiology from

259

00:10:21,509 --> 00:10:20,160

biology

260

00:10:24,550 --> 00:10:21,519

is it

261

00:10:29,910 --> 00:10:24,560

difficult

262

00:10:29,920 --> 00:10:34,150

um

263

00:10:37,269 --> 00:10:35,269

yeah sure i was just going to say

264

00:10:39,030 --> 00:10:37,279

astrobiology may not be biology at all i

265

00:10:41,269 --> 00:10:39,040

mean astrobiology is kind of a blanket

266

00:10:42,230 --> 00:10:41,279

term for a very interdisciplinary uh

267

00:10:43,910 --> 00:10:42,240

study

268

00:10:45,430 --> 00:10:43,920

and at its core of course we have this

269

00:10:47,509 --> 00:10:45,440

search for life in the universe but you

270

00:10:49,509 --> 00:10:47,519

can still be an astrobiologist and and

271

00:10:51,430 --> 00:10:49,519

sort of study interiors of planets or or

272

00:10:53,030 --> 00:10:51,440

whatever uh as long as you're feeding

273

00:10:54,630 --> 00:10:53,040

into this theme of trying to understand

274

00:10:56,790 --> 00:10:54,640

the distribution and type of habit of

275

00:10:58,310 --> 00:10:56,800

worlds that might be out there so the

276

00:10:59,990 --> 00:10:58,320

difference between i think astrobiology

277

00:11:02,310 --> 00:11:00,000

and biology is you know biology is a

278

00:11:04,389 --> 00:11:02,320

specific discipline that looks at life

279

00:11:06,389 --> 00:11:04,399

whereas astrobiology brings together

280

00:11:08,550 --> 00:11:06,399

many disciplines to answer the question

281

00:11:10,069 --> 00:11:08,560

of where life is in the universe and

282

00:11:12,389 --> 00:11:10,079

where we might find it and what it might

283

00:11:15,990 --> 00:11:12,399

be like

284

00:11:19,829 --> 00:11:17,590

yeah i would add something to that that

285

00:11:21,590 --> 00:11:19,839

that for me goes to

286

00:11:23,750 --> 00:11:21,600

each of the next two questions and that

287

00:11:25,990 --> 00:11:23,760

is i think that biology has followed a

288

00:11:27,750 --> 00:11:26,000

path that is appropriately very specific

289

00:11:30,150 --> 00:11:27,760

i mean the revolution that's happening

290

00:11:31,910 --> 00:11:30,160

in biology over the last decade or so

291

00:11:33,509 --> 00:11:31,920

is enabled by tools that are incredibly

292

00:11:35,110 --> 00:11:33,519

specific to our kind of life and our

293

00:11:37,030 --> 00:11:35,120

kind of biochemistry and i think one of

294

00:11:39,670 --> 00:11:37,040

the real critical needs

295

00:11:41,110 --> 00:11:39,680

uh in astrobiology for for defining what

296

00:11:42,630 --> 00:11:41,120

are appropriate biosignatures for

297

00:11:44,470 --> 00:11:42,640

understanding what habitability really

298

00:11:46,310 --> 00:11:44,480

means is that we need to take a more

299

00:11:48,150 --> 00:11:46,320

general perspective and understand life

300

00:11:49,430 --> 00:11:48,160

in its fundamental aspects and and in

301
00:11:50,949 --> 00:11:49,440
some way

302
00:11:52,150 --> 00:11:50,959
you know in some forms

303
00:11:53,910 --> 00:11:52,160
um

304
00:11:55,750 --> 00:11:53,920
that runs a little bit different to the

305
00:11:58,710 --> 00:11:55,760
way that biology is unfolding a lot of

306
00:12:00,150 --> 00:11:58,720
the tools that we use are similar

307
00:12:01,910 --> 00:12:00,160
but i think the perspective that we have

308
00:12:03,910 --> 00:12:01,920
to take on the life itself is different

309
00:12:05,590 --> 00:12:03,920
rather than an incredibly specific

310
00:12:08,310 --> 00:12:05,600
perspective i think we need to be

311
00:12:09,430 --> 00:12:08,320
generalists and so in some ways

312
00:12:11,590 --> 00:12:09,440
you know the biology part in

313
00:12:13,030 --> 00:12:11,600

astrobiology is as much chemistry as it

314

00:12:15,110 --> 00:12:13,040

is uh

315

00:12:16,629 --> 00:12:15,120

biology and and for me that becomes

316

00:12:20,710 --> 00:12:16,639

important in considering these next two

317

00:12:24,870 --> 00:12:22,790

chris earlier on i saw you flick

318

00:12:27,269 --> 00:12:24,880

yourself off mute was there something

319

00:12:29,350 --> 00:12:27,279

you wanted to add on there

320

00:12:30,949 --> 00:12:29,360

well i was just uh i i think victoria

321

00:12:33,430 --> 00:12:30,959

had said basically what i was going to

322

00:12:34,870 --> 00:12:33,440

say is that the critical

323

00:12:36,550 --> 00:12:34,880

one of the critical differences between

324

00:12:38,389 --> 00:12:36,560

astrobiology and biology is certainly

325

00:12:40,150 --> 00:12:38,399

not just hardcore biology it is

326

00:12:41,990 --> 00:12:40,160

fundamentally different fields

327

00:12:44,069 --> 00:12:42,000

and victoria covered that

328

00:12:46,949 --> 00:12:44,079

and i also agree with tori that it's

329

00:12:51,110 --> 00:12:46,959

very much chemistry and geochemistry and

330

00:12:52,550 --> 00:12:51,120

geology because we're talking about

331

00:12:54,949 --> 00:12:52,560

uh um

332

00:12:57,509 --> 00:12:54,959

looking for the chemistry of life

333

00:12:58,629 --> 00:12:57,519

byproducts of life in the atmosphere

334

00:13:05,750 --> 00:12:58,639

metaboli

335

00:13:07,269 --> 00:13:05,760

not necessarily what biologists do

336

00:13:12,230 --> 00:13:07,279

when they're they're very specific

337

00:13:17,509 --> 00:13:14,870

michael can you can you hear us and do

338

00:13:19,590 --> 00:13:17,519

you have a mic

339

00:13:20,470 --> 00:13:19,600

yeah i do

340

00:13:22,870 --> 00:13:20,480

okay

341

00:13:25,750 --> 00:13:22,880

um so thankful uh

342

00:13:28,150 --> 00:13:25,760

yeah we can so for our participants

343

00:13:29,910 --> 00:13:28,160

because michael um joined just at the

344

00:13:32,829 --> 00:13:29,920

start of this actually would you like to

345

00:13:37,190 --> 00:13:35,110

yourself michael new i'm the

346

00:13:38,470 --> 00:13:37,200

astrobiology discipline scientist nasa

347

00:13:40,710 --> 00:13:38,480

headquarters

348

00:13:43,590 --> 00:13:40,720

uh which means i helped run the

349

00:13:45,670 --> 00:13:43,600

astrobiology program

350

00:13:47,350 --> 00:13:45,680

part that running the astrology program

351

00:13:50,870 --> 00:13:47,360

means uh putting this kind of thing

352

00:13:56,790 --> 00:13:50,880

together and trying to develop a broadly

353

00:13:59,750 --> 00:13:57,829

and

354

00:14:02,310 --> 00:13:59,760

you were responsible along with your

355

00:14:04,069 --> 00:14:02,320

colleagues for starting to pull together

356

00:14:06,150 --> 00:14:04,079

some of these questions

357

00:14:08,470 --> 00:14:06,160

is there anything that you want to add

358

00:14:10,790 --> 00:14:08,480

in terms of um

359

00:14:12,310 --> 00:14:10,800

describing what you do

360

00:14:13,670 --> 00:14:12,320

to the non-scientists because i imagine

361

00:14:16,870 --> 00:14:13,680

you must have to do this on a fairly

362

00:14:20,710 --> 00:14:16,880

regular basis

363

00:14:22,550 --> 00:14:20,720

well the usual description i give is

364

00:14:24,150 --> 00:14:22,560

we're looking for evidence of life in

365

00:14:25,509 --> 00:14:24,160

the soul in this solar system or other

366

00:14:26,310 --> 00:14:25,519

solar systems

367

00:14:28,150 --> 00:14:26,320

and

368

00:14:30,550 --> 00:14:28,160

the only example of life we have is

369

00:14:32,389 --> 00:14:30,560

earth and so we try to use what we know

370

00:14:34,470 --> 00:14:32,399

about the origin the evolution the

371

00:14:37,269 --> 00:14:34,480

distribution of life on earth

372

00:14:39,829 --> 00:14:37,279

uh in the future of life in order

373

00:14:41,590 --> 00:14:39,839

to try to extrapolate to other bodies

374

00:14:42,790 --> 00:14:41,600

other places and sources from other

375

00:14:45,590 --> 00:14:42,800

places in

376

00:14:48,069 --> 00:14:45,600

the universe so that's basically my

377

00:14:50,470 --> 00:14:48,079

three second uh elevator speech for what

378

00:14:52,949 --> 00:14:50,480

it is i do

379

00:14:55,269 --> 00:14:52,959

cool thank you

380

00:14:56,710 --> 00:14:55,279

all right um stamveros i've been just

381

00:14:58,389 --> 00:14:56,720

looking out of the corner of my eyes so

382

00:15:01,350 --> 00:14:58,399

anything we want to pick up

383

00:15:02,470 --> 00:15:01,360

from the chat at the moment because i

384

00:15:04,470 --> 00:15:02,480

see uh

385

00:15:06,389 --> 00:15:04,480

where's my quite a few people quite a

386

00:15:08,069 --> 00:15:06,399

few people were expressing their their

387

00:15:09,350 --> 00:15:08,079

answer to the question which i think is

388

00:15:11,350 --> 00:15:09,360

great and there's a nice little back

389

00:15:13,670 --> 00:15:11,360

channel chat going on we'll have about

390

00:15:15,269 --> 00:15:13,680

20 minutes of comment and q a at the end

391

00:15:18,310 --> 00:15:15,279

but please continue the back channel

392

00:15:22,150 --> 00:15:18,320

chatting it's very engaging

393

00:15:26,710 --> 00:15:25,509

but quick question for michael knew

394

00:15:28,550 --> 00:15:26,720

and i don't know

395

00:15:30,150 --> 00:15:28,560

obviously other people can also have

396

00:15:32,069 --> 00:15:30,160

answers to this question

397

00:15:34,710 --> 00:15:32,079

but coming from the planetary science

398

00:15:37,910 --> 00:15:34,720

side i'm actually not super familiar

399

00:15:40,629 --> 00:15:37,920

with what the ultimate purposes of the

400

00:15:43,110 --> 00:15:40,639

astrobiology roadmap are what they'll

401
00:15:45,670 --> 00:15:43,120
this document will be used for and how

402
00:15:49,350 --> 00:15:45,680
it's different from detailed surveys

403
00:15:52,550 --> 00:15:50,710
okay so

404
00:15:55,189 --> 00:15:52,560
astrobiology doesn't have a decadal

405
00:15:57,189 --> 00:15:55,199
survey it's we're a sub-part of the

406
00:15:58,949 --> 00:15:57,199
planetary science division

407
00:16:01,110 --> 00:15:58,959
so if you go to look at the planetary

408
00:16:03,189 --> 00:16:01,120
science uh the cable survey that came

409
00:16:05,509 --> 00:16:03,199
out about a year ago

410
00:16:07,749 --> 00:16:05,519
there is no section called astrobiology

411
00:16:09,829 --> 00:16:07,759
but if you read it

412
00:16:13,430 --> 00:16:09,839
ideas from astrobiology completely

413
00:16:16,550 --> 00:16:15,509

because we never had a decadal survey

414

00:16:18,870 --> 00:16:16,560

per se

415

00:16:20,790 --> 00:16:18,880

and because we've always wanted

416

00:16:22,710 --> 00:16:20,800

astrobiology to have some kind of

417

00:16:24,470 --> 00:16:22,720

grounding in what the community thinks

418

00:16:26,310 --> 00:16:24,480

is important

419

00:16:27,829 --> 00:16:26,320

we've been developing these roadmaps we

420

00:16:30,470 --> 00:16:27,839

did the first one in

421

00:16:32,710 --> 00:16:30,480

2003 it was a revision

422

00:16:35,350 --> 00:16:32,720

a big major revision and then

423

00:16:38,150 --> 00:16:35,360

2008 was a minor tweak

424

00:16:39,990 --> 00:16:38,160

and now it's time to really reset it and

425

00:16:41,829 --> 00:16:40,000

ask you know what have we done will be

426
00:16:45,350 --> 00:16:41,839
accomplished and what are our goals for

427
00:16:47,590 --> 00:16:45,360
the next 10 years so in a sense it is a

428
00:16:49,990 --> 00:16:47,600
it's more like a science strategy than

429
00:16:52,069 --> 00:16:50,000
it is a cable survey in that it doesn't

430
00:16:54,230 --> 00:16:52,079
say you shall do this mission or you

431
00:16:56,470 --> 00:16:54,240
must do these measurements but it lays

432
00:16:58,870 --> 00:16:56,480
out the science uh

433
00:17:00,389 --> 00:16:58,880
goals objectives and experiments that

434
00:17:06,630 --> 00:17:00,399
you kind of want to do

435
00:17:11,350 --> 00:17:08,710
great

436
00:17:13,270 --> 00:17:11,360
all right so we we've sort of outlined

437
00:17:15,669 --> 00:17:13,280
our understanding of how we explain it

438
00:17:17,829 --> 00:17:15,679

and uh why it's uh

439

00:17:20,309 --> 00:17:17,839

why it's so challenging in some ways

440

00:17:23,350 --> 00:17:20,319

let's move on to the second point about

441

00:17:25,590 --> 00:17:23,360

the most important research um for

442

00:17:26,949 --> 00:17:25,600

identifying extraterrestrial life and i

443

00:17:28,710 --> 00:17:26,959

have to admit even saying

444

00:17:30,710 --> 00:17:28,720

extraterrestrial life i find quite

445

00:17:31,590 --> 00:17:30,720

exciting um

446

00:17:33,750 --> 00:17:31,600

so

447

00:17:35,590 --> 00:17:33,760

what do we have to do

448

00:17:50,549 --> 00:17:35,600

what's the critical research we've got

449

00:17:53,190 --> 00:17:51,909

i mean i suppose this is one where we're

450

00:17:55,669 --> 00:17:53,200

all gonna be a little bit more biased

451
00:17:58,710 --> 00:17:55,679
but in my own opinion um i would say

452
00:18:02,310 --> 00:17:58,720
that that we need to be focusing on on

453
00:18:04,789 --> 00:18:02,320
chemistry and geochemistry that is

454
00:18:06,470 --> 00:18:04,799
a product of life that can indirectly

455
00:18:10,150 --> 00:18:06,480
detect to tell us whether life was

456
00:18:11,750 --> 00:18:10,160
present past or or active life um

457
00:18:13,990 --> 00:18:11,760
and the reason for that is that

458
00:18:15,270 --> 00:18:14,000
ultimately when you do solar systems

459
00:18:16,470 --> 00:18:15,280
exploration

460
00:18:18,070 --> 00:18:16,480
we're going to be talking about

461
00:18:20,470 --> 00:18:18,080
environments where the where an active

462
00:18:23,350 --> 00:18:20,480
biosphere could be very very deep in in

463
00:18:25,430 --> 00:18:23,360

the subsurface or or subsurface planet

464

00:18:27,350 --> 00:18:25,440

or subsurface ice or

465

00:18:30,070 --> 00:18:27,360

on an exoplanet and in in all these

466

00:18:32,150 --> 00:18:30,080

cases uh far removed from potentially

467

00:18:35,669 --> 00:18:32,160

far removed from the observation or of

468

00:18:37,350 --> 00:18:35,679

life could be fossil life where now um

469

00:18:39,830 --> 00:18:37,360

the chances of finding the chemistry

470

00:18:42,470 --> 00:18:39,840

that that fos that organism left

471

00:18:43,990 --> 00:18:42,480

billions of years ago is potentially

472

00:18:49,430 --> 00:18:44,000

more likely than finding the actual

473

00:18:49,440 --> 00:18:54,310

so we have a vote for geochemistry

474

00:18:58,710 --> 00:18:56,390

where else what else do we be should we

475

00:18:59,510 --> 00:18:58,720

be focusing on

476

00:19:00,789 --> 00:18:59,520

um

477

00:19:02,630 --> 00:19:00,799

victoria

478

00:19:04,390 --> 00:19:02,640

yeah so so i want to say you know from

479

00:19:05,909 --> 00:19:04,400

the i'm i'm in a very different field to

480

00:19:07,430 --> 00:19:05,919

chris my priorities will be different so

481

00:19:09,110 --> 00:19:07,440

i want to say from my point of view for

482

00:19:11,029 --> 00:19:09,120

extrasolar planets i think we really

483

00:19:12,870 --> 00:19:11,039

need to focus on defining new bio

484

00:19:14,230 --> 00:19:12,880

signatures um that aren't the standard

485

00:19:15,510 --> 00:19:14,240

ones associated with oxygenic

486

00:19:16,470 --> 00:19:15,520

photosynthesis

487

00:19:17,990 --> 00:19:16,480

um

488

00:19:19,909 --> 00:19:18,000

for earth-like planets orbiting sunlight

489

00:19:21,510 --> 00:19:19,919

stars that sort of kind of that that's a

490

00:19:24,150 --> 00:19:21,520

core and and maybe we can make very good

491

00:19:25,590 --> 00:19:24,160

arguments for why you know an ecosystem

492

00:19:27,510 --> 00:19:25,600

will eventually evolve to support

493

00:19:28,710 --> 00:19:27,520

photosynthesis but i think we need to

494

00:19:30,549 --> 00:19:28,720

look at these other potential

495

00:19:32,549 --> 00:19:30,559

atmospheric biosignatures as well or

496

00:19:34,150 --> 00:19:32,559

surface fire signatures because we don't

497

00:19:36,070 --> 00:19:34,160

do this then we lower our chances of

498

00:19:38,549 --> 00:19:36,080

succeeding in the search for life life

499

00:19:40,070 --> 00:19:38,559

elsewhere and we also lose sort of an

500

00:19:43,029 --> 00:19:40,080

understanding of the potential diversity

501
00:19:44,630 --> 00:19:43,039
of life and planetary systems out there

502
00:19:46,070 --> 00:19:44,640
but to do this

503
00:19:47,750 --> 00:19:46,080
what goes with this is an improved

504
00:19:49,669 --> 00:19:47,760
understanding of how biosignatures

505
00:19:51,190 --> 00:19:49,679
interact with the environment and can be

506
00:19:53,110 --> 00:19:51,200
discriminated in the context of the

507
00:19:55,190 --> 00:19:53,120
environment um

508
00:19:56,549 --> 00:19:55,200
and so so i think that study as well

509
00:19:58,150 --> 00:19:56,559
will probably inform all these this

510
00:19:59,750 --> 00:19:58,160
other biosignature research as well

511
00:20:01,590 --> 00:19:59,760
which looks at again you know life

512
00:20:03,430 --> 00:20:01,600
leaving its imprint on on a planetary

513
00:20:06,950 --> 00:20:03,440

environment whether it be on mars or

514

00:20:10,710 --> 00:20:06,960

europa or wherever

515

00:20:12,070 --> 00:20:10,720

out of curiosity have we found anything

516

00:20:13,590 --> 00:20:12,080

that would

517

00:20:15,510 --> 00:20:13,600

indicate

518

00:20:17,510 --> 00:20:15,520

alternative um and i know i'm being

519

00:20:22,310 --> 00:20:17,520

slightly self-indulgent here but

520

00:20:27,110 --> 00:20:24,870

what i'm talking about here is uh

521

00:20:28,630 --> 00:20:27,120

looking at uh you might not think of it

522

00:20:30,630 --> 00:20:28,640

so much an alternative signature but an

523

00:20:32,470 --> 00:20:30,640

alternative dominance so for example you

524

00:20:34,870 --> 00:20:32,480

could have a biosphere that's dominated

525

00:20:36,149 --> 00:20:34,880

by sulfur metabolizing bacteria for

526

00:20:37,590 --> 00:20:36,159

example and that will produce a very

527

00:20:39,990 --> 00:20:37,600

different signature in the atmosphere

528

00:20:42,310 --> 00:20:40,000

than say oxygenic

529

00:20:44,950 --> 00:20:42,320

oxygenic photosynthesis from plants so i

530

00:20:46,470 --> 00:20:44,960

think we can certainly look at

531

00:20:50,230 --> 00:20:46,480

different metabolic

532

00:20:52,310 --> 00:20:50,240

and how those interact with the planet's

533

00:20:53,990 --> 00:20:52,320

environment and also the light that's

534

00:20:55,270 --> 00:20:54,000

coming in from its parent star because

535

00:20:56,950 --> 00:20:55,280

if the light from the parent star

536

00:20:58,230 --> 00:20:56,960

changes that changes the photochemistry

537

00:21:00,070 --> 00:20:58,240

in the atmosphere and it changes what

538

00:21:01,669 --> 00:21:00,080

kind of signature you get so these

539

00:21:03,110 --> 00:21:01,679

alternative bio signatures are kind of a

540

00:21:05,190 --> 00:21:03,120

function of three different steps you

541

00:21:06,870 --> 00:21:05,200

know alternative metabolism dominant

542

00:21:09,590 --> 00:21:06,880

metabolism making them

543

00:21:12,070 --> 00:21:09,600

their their uh journey within their own

544

00:21:13,430 --> 00:21:12,080

atmosphere and and how they're um

545

00:21:14,789 --> 00:21:13,440

affected by the light from their

546

00:21:16,470 --> 00:21:14,799

different parent star in a different

547

00:21:18,070 --> 00:21:16,480

atmosphere for example and then

548

00:21:21,029 --> 00:21:18,080

ultimately what we might see in the

549

00:21:23,029 --> 00:21:21,039

spectrum for these things

550

00:21:24,710 --> 00:21:23,039

thanks okay

551
00:21:26,070 --> 00:21:24,720
i'll add a bit to what chris and vicky

552
00:21:27,190 --> 00:21:26,080
both have said

553
00:21:28,870 --> 00:21:27,200
because i think they're talking about

554
00:21:31,430 --> 00:21:28,880
different sides of the same coin they're

555
00:21:32,630 --> 00:21:31,440
they're in each case uh talking about

556
00:21:34,870 --> 00:21:32,640
features

557
00:21:36,950 --> 00:21:34,880
that are product of life processes but

558
00:21:38,630 --> 00:21:36,960
not the life itself

559
00:21:40,789 --> 00:21:38,640
and in both cases i think the real

560
00:21:42,870 --> 00:21:40,799
concern is understanding you know

561
00:21:45,350 --> 00:21:42,880
because these are features that that

562
00:21:47,909 --> 00:21:45,360
might well arise from non-living

563
00:21:48,950 --> 00:21:47,919

processes as well and features that

564

00:21:51,110 --> 00:21:48,960

inherently

565

00:21:52,390 --> 00:21:51,120

don't contain a huge amount of specific

566

00:21:54,470 --> 00:21:52,400

information

567

00:21:56,549 --> 00:21:54,480

um there's a danger in mistaking them

568

00:21:58,630 --> 00:21:56,559

for for you know in getting false

569

00:22:00,470 --> 00:21:58,640

positives i think from abiotic processes

570

00:22:03,110 --> 00:22:00,480

and so i think for

571

00:22:04,630 --> 00:22:03,120

uh for features that are are

572

00:22:06,789 --> 00:22:04,640

meant to serve as evidence of life

573

00:22:08,630 --> 00:22:06,799

processes but not life itself

574

00:22:09,990 --> 00:22:08,640

i think there's an an important standard

575

00:22:11,669 --> 00:22:10,000

that sort of has to be met you know when

576

00:22:13,750 --> 00:22:11,679

does that feature rise to the level of

577

00:22:15,669 --> 00:22:13,760

saying okay this is this is different

578

00:22:18,470 --> 00:22:15,679

enough that although it's not life

579

00:22:20,149 --> 00:22:18,480

itself we can't envision it uh having

580

00:22:22,310 --> 00:22:20,159

come from from

581

00:22:23,590 --> 00:22:22,320

anything other than life processes so i

582

00:22:25,350 --> 00:22:23,600

think it's a question of degree when we

583

00:22:26,549 --> 00:22:25,360

talk about these features

584

00:22:28,870 --> 00:22:26,559

and then on the other hand when you do

585

00:22:30,789 --> 00:22:28,880

go looking for for the life itself or

586

00:22:32,950 --> 00:22:30,799

for molecules or features

587

00:22:35,270 --> 00:22:32,960

uh that may be a product of life i think

588

00:22:37,590 --> 00:22:35,280

there's a different concern and that is

589

00:22:39,750 --> 00:22:37,600

you know we understand how to recognize

590

00:22:41,750 --> 00:22:39,760

something as specific as the molecules

591

00:22:43,430 --> 00:22:41,760

of our own biochemistry but there's a

592

00:22:45,510 --> 00:22:43,440

danger then and going looking for those

593

00:22:46,789 --> 00:22:45,520

specific molecules or features something

594

00:22:49,510 --> 00:22:46,799

like them so

595

00:22:50,870 --> 00:22:49,520

how do you how do you understand um how

596

00:22:52,149 --> 00:22:50,880

to look for a very specific thing

597

00:22:53,350 --> 00:22:52,159

something that does carry so much

598

00:22:55,190 --> 00:22:53,360

information that it's a clear

599

00:22:56,950 --> 00:22:55,200

representative of life

600

00:22:59,110 --> 00:22:56,960

but is not in the specific line that our

601
00:23:00,390 --> 00:22:59,120
biochemistry is chosen

602
00:23:03,990 --> 00:23:00,400
and i think all of those are challenges

603
00:23:04,000 --> 00:23:06,470
okay

604
00:23:06,480 --> 00:23:09,750
kelsey

605
00:23:13,590 --> 00:23:11,990
looks like her video may have frozen

606
00:23:16,470 --> 00:23:13,600
right because are you still with us on

607
00:23:18,789 --> 00:23:16,480
audio can you hear me yeah

608
00:23:20,710 --> 00:23:18,799
um yeah so i

609
00:23:21,750 --> 00:23:20,720
from my bias working in the outer solar

610
00:23:23,590 --> 00:23:21,760
system

611
00:23:25,110 --> 00:23:23,600
it's kind of similar to other people i'm

612
00:23:26,310 --> 00:23:25,120
i'm basically interested in learning

613
00:23:27,669 --> 00:23:26,320

more about what we could actually

614

00:23:30,310 --> 00:23:27,679

potentially

615

00:23:32,070 --> 00:23:30,320

check for when we send spacecraft and

616

00:23:34,630 --> 00:23:32,080

really we're still at the point of we

617

00:23:36,789 --> 00:23:34,640

need to gather a lot of other basic data

618

00:23:39,110 --> 00:23:36,799

but it's still good to look forward and

619

00:23:41,190 --> 00:23:39,120

think about what would actually be able

620

00:23:44,310 --> 00:23:41,200

to be detected in these kind of

621

00:23:45,909 --> 00:23:44,320

environments um so for us it's icy moons

622

00:23:48,549 --> 00:23:45,919

um so it's very similar to what other

623

00:23:53,590 --> 00:23:51,430

so just coming back to um

624

00:23:55,350 --> 00:23:53,600

slightly more detailed questions we're

625

00:23:56,950 --> 00:23:55,360

thinking about the most important

626
00:23:59,029 --> 00:23:56,960
research

627
00:24:00,390 --> 00:23:59,039
to conduct if you

628
00:24:02,710 --> 00:24:00,400
you were given

629
00:24:05,510 --> 00:24:02,720
reasonably large amounts of money you

630
00:24:07,190 --> 00:24:05,520
had to spend it on something to move the

631
00:24:09,269 --> 00:24:07,200
field forward

632
00:24:12,390 --> 00:24:09,279
but you could only do one thing what

633
00:24:14,549 --> 00:24:12,400
what would you spend the money on kelsey

634
00:24:16,549 --> 00:24:14,559
start with you

635
00:24:18,630 --> 00:24:16,559
sure i guess it's kind of similar to my

636
00:24:19,510 --> 00:24:18,640
last answer

637
00:24:21,350 --> 00:24:19,520
but

638
00:24:23,750 --> 00:24:21,360

for us in the outer solar system we have

639

00:24:26,310 --> 00:24:23,760

some really fascinating moons that could

640

00:24:28,390 --> 00:24:26,320

definitely potentially be places life

641

00:24:30,630 --> 00:24:28,400

could exist and of course there's been

642

00:24:32,149 --> 00:24:30,640

lots of speculation about that

643

00:24:34,630 --> 00:24:32,159

just because there is liquid water in a

644

00:24:37,110 --> 00:24:34,640

lot of cases um and and other things

645

00:24:39,590 --> 00:24:37,120

that are considered necessary for life

646

00:24:42,070 --> 00:24:39,600

um so for us we would love to you know

647

00:24:44,630 --> 00:24:42,080

spend lots of money uh sending

648

00:24:46,230 --> 00:24:44,640

spacecraft out there and basically um

649

00:24:48,549 --> 00:24:46,240

even getting information about these

650

00:24:50,230 --> 00:24:48,559

surfaces we use the surface information

651
00:24:53,029 --> 00:24:50,240
to understand the interior and the

652
00:24:55,029 --> 00:24:53,039
potential environments in there

653
00:24:56,870 --> 00:24:55,039
there's places in the outer solar system

654
00:24:58,710 --> 00:24:56,880
that haven't even been imaged

655
00:25:01,990 --> 00:24:58,720
so we have a lot of work to do and

656
00:25:03,430 --> 00:25:02,000
certainly just basic you know imaging

657
00:25:06,630 --> 00:25:03,440
spectroscopy

658
00:25:07,590 --> 00:25:06,640
uh radar for subsurface imaging of ic

659
00:25:10,230 --> 00:25:07,600
worlds

660
00:25:10,950 --> 00:25:10,240
that would be great for us

661
00:25:13,430 --> 00:25:10,960
so

662
00:25:15,750 --> 00:25:13,440
is it a case that the technology that we

663
00:25:17,750 --> 00:25:15,760

have is good enough we just have to get

664

00:25:19,190 --> 00:25:17,760

it out there or are there still

665

00:25:21,430 --> 00:25:19,200

significant

666

00:25:22,789 --> 00:25:21,440

barriers in terms of resolution and this

667

00:25:25,350 --> 00:25:22,799

sort of thing

668

00:25:27,269 --> 00:25:25,360

well it depends on the the world um for

669

00:25:28,390 --> 00:25:27,279

some place like europa there's a lot of

670

00:25:31,110 --> 00:25:28,400

technology

671

00:25:33,510 --> 00:25:31,120

that hasn't been sent the last mission

672

00:25:35,029 --> 00:25:33,520

ended in the early 2000s

673

00:25:36,549 --> 00:25:35,039

so as you can imagine there's a lot that

674

00:25:38,230 --> 00:25:36,559

could be sent there

675

00:25:39,909 --> 00:25:38,240

especially something like an ice

676

00:25:41,430 --> 00:25:39,919

penetrating radar

677

00:25:43,269 --> 00:25:41,440

in other words

678

00:25:44,390 --> 00:25:43,279

some technology development does need to

679

00:25:46,470 --> 00:25:44,400

be done

680

00:25:48,310 --> 00:25:46,480

in some cases even for europa it would

681

00:25:51,830 --> 00:25:48,320

be helpful to have better

682

00:25:53,830 --> 00:25:51,840

radiation hard products

683

00:25:55,269 --> 00:25:53,840

but in some cases just to get the mass

684

00:25:57,350 --> 00:25:55,279

to the outer solar system we need some

685

00:26:00,390 --> 00:25:57,360

more creative technologies

686

00:26:02,710 --> 00:26:00,400

either for power systems or for uh

687

00:26:04,549 --> 00:26:02,720

somehow capturing uh spacecraft into

688

00:26:06,470 --> 00:26:04,559

orbit

689

00:26:08,070 --> 00:26:06,480

those both

690

00:26:09,909 --> 00:26:08,080

okay

691

00:26:13,430 --> 00:26:09,919

chris where would you spend your

692

00:26:17,269 --> 00:26:15,590

well i mean i think i've seen the chat

693

00:26:19,029 --> 00:26:17,279

room open up with everyone's favorite

694

00:26:19,750 --> 00:26:19,039

mission and there's our there are a lot

695

00:26:21,510 --> 00:26:19,760

of

696

00:26:23,990 --> 00:26:21,520

great missions that we the people have

697

00:26:26,470 --> 00:26:24,000

dreamt up and i'm going to stay agnostic

698

00:26:29,029 --> 00:26:26,480

in that debate although i will

699

00:26:30,950 --> 00:26:29,039

second kelsey's uh plea that we need to

700

00:26:32,230 --> 00:26:30,960

get back to the outer solar system

701
00:26:33,510 --> 00:26:32,240
now within the outer solar system

702
00:26:35,190 --> 00:26:33,520
there's at least three or four places

703
00:26:36,630 --> 00:26:35,200
that we need to get back to so

704
00:26:38,149 --> 00:26:36,640
so i'm going to stay neutral there in

705
00:26:40,789 --> 00:26:38,159
terms of the astrobiology budget which

706
00:26:42,870 --> 00:26:40,799
is usually not a missions budget um you

707
00:26:45,909 --> 00:26:42,880
know i think that

708
00:26:48,310 --> 00:26:45,919
we do need to be developing better

709
00:26:50,549 --> 00:26:48,320
both time-tested approaches to life

710
00:26:52,710 --> 00:26:50,559
detection and out-of-the-box approaches

711
00:26:55,669 --> 00:26:52,720
and that's not just for

712
00:26:57,269 --> 00:26:55,679
um you know rock samples that includes

713
00:26:59,110 --> 00:26:57,279

victoria's um

714

00:27:00,630 --> 00:26:59,120

plea about atmospheric signatures i

715

00:27:02,789 --> 00:27:00,640

completely agree with her

716

00:27:04,630 --> 00:27:02,799

that that you know worlds that didn't

717

00:27:06,390 --> 00:27:04,640

generate oxygen are the most likely

718

00:27:08,230 --> 00:27:06,400

worlds you can see

719

00:27:11,110 --> 00:27:08,240

and in the next if we talk about a

720

00:27:13,350 --> 00:27:11,120

decade here is our time scale that's

721

00:27:15,830 --> 00:27:13,360

that's the right time scale for starting

722

00:27:17,830 --> 00:27:15,840

to get some um

723

00:27:19,669 --> 00:27:17,840

some first data on on exoplanet

724

00:27:22,870 --> 00:27:19,679

atmospheres around red

725

00:27:25,029 --> 00:27:22,880

i mean uh sorry around red dwarfs so um

726

00:27:26,710 --> 00:27:25,039

so i i think that that's where i would

727

00:27:28,950 --> 00:27:26,720

put my embarrassingly large amount of

728

00:27:31,830 --> 00:27:28,960

money is into into

729

00:27:34,230 --> 00:27:31,840

work on metabolisms and and the

730

00:27:36,789 --> 00:27:34,240

potential signatures they would produce

731

00:27:39,669 --> 00:27:36,799

um that that might inform both the mars

732

00:27:42,230 --> 00:27:39,679

mission or the rover in 2020

733

00:27:44,070 --> 00:27:42,240

as well as as these initial exoplanet

734

00:27:45,830 --> 00:27:44,080

missions

735

00:27:47,430 --> 00:27:45,840

excellent thank you always good to know

736

00:27:48,549 --> 00:27:47,440

we won't have difficulty spending the

737

00:27:51,590 --> 00:27:48,559

money

738

00:27:53,190 --> 00:27:51,600

dory what do you want to add to it

739

00:27:54,870 --> 00:27:53,200

uh so i would pick up a theme that vicky

740

00:27:56,389 --> 00:27:54,880

raised earlier and i i also thought it

741

00:27:57,750 --> 00:27:56,399

was kind of interesting that that i

742

00:27:59,590 --> 00:27:57,760

don't think you'd finish speaking that

743

00:28:02,230 --> 00:27:59,600

sentence before mission uh wishes

744

00:28:03,510 --> 00:28:02,240

started to pop up in the in the chat but

745

00:28:05,510 --> 00:28:03,520

i mean suppose that that thing could

746

00:28:07,750 --> 00:28:05,520

launch tomorrow do we feel like we have

747

00:28:08,630 --> 00:28:07,760

the the context from observation and

748

00:28:10,230 --> 00:28:08,640

theory

749

00:28:12,230 --> 00:28:10,240

uh to say exactly what instruments

750

00:28:13,350 --> 00:28:12,240

should go on that spacecraft and to be

751
00:28:16,470 --> 00:28:13,360
sure that

752
00:28:18,549 --> 00:28:16,480
having spent the money uh whatever we

753
00:28:19,909 --> 00:28:18,559
see you know that that

754
00:28:21,350 --> 00:28:19,919
we knew a clear signature that we were

755
00:28:22,630 --> 00:28:21,360
looking for um do we understand enough

756
00:28:25,029 --> 00:28:22,640
about the context in which that

757
00:28:27,350 --> 00:28:25,039
signature is formed uh that we could do

758
00:28:28,630 --> 00:28:27,360
a good concrete job of saying you know

759
00:28:29,990 --> 00:28:28,640
you spent the money and here's the

760
00:28:31,750 --> 00:28:30,000
answer

761
00:28:34,389 --> 00:28:31,760
so i think that that money to go into

762
00:28:35,590 --> 00:28:34,399
the sorts of of um things that vicky was

763
00:28:37,110 --> 00:28:35,600

talking about earlier you know

764

00:28:38,470 --> 00:28:37,120

understanding the the environmental

765

00:28:39,590 --> 00:28:38,480

context how is it that what you're

766

00:28:41,669 --> 00:28:39,600

looking for

767

00:28:43,430 --> 00:28:41,679

interacts with its host environment uh

768

00:28:46,230 --> 00:28:43,440

in ways that may give you false positive

769

00:28:47,430 --> 00:28:46,240

or erase a positive signature

770

00:28:50,230 --> 00:28:47,440

are critical and that is within the

771

00:28:51,990 --> 00:28:50,240

scope of astrobiology

772

00:28:55,430 --> 00:28:52,000

and is that something we can quite

773

00:28:57,350 --> 00:28:55,440

happily do on earth can we simulate it

774

00:28:59,669 --> 00:28:57,360

throw large enough computers at it is it

775

00:29:01,190 --> 00:28:59,679

that kind of problem or have we got to

776

00:29:02,710 --> 00:29:01,200

go to ground truth

777

00:29:04,149 --> 00:29:02,720

out there

778

00:29:07,190 --> 00:29:04,159

i think it's a mixture of things i i

779

00:29:09,190 --> 00:29:07,200

think it's an iteration between uh

780

00:29:10,389 --> 00:29:09,200

between theory and modeling between

781

00:29:13,590 --> 00:29:10,399

observations that can be done in

782

00:29:15,110 --> 00:29:13,600

environments here that may not be uh

783

00:29:16,549 --> 00:29:15,120

perfect examples of what we're looking

784

00:29:18,070 --> 00:29:16,559

at elsewhere but

785

00:29:20,630 --> 00:29:18,080

you know but in which we can identify

786

00:29:22,230 --> 00:29:20,640

some features that make them similar

787

00:29:23,750 --> 00:29:22,240

and then whatever we're able to do with

788

00:29:25,190 --> 00:29:23,760

with observations that may not be

789

00:29:27,669 --> 00:29:25,200

specifically targeted at the life

790

00:29:29,430 --> 00:29:27,679

question but nonetheless give us enough

791

00:29:31,590 --> 00:29:29,440

contextual information about the

792

00:29:34,230 --> 00:29:31,600

potential target that we understand

793

00:29:35,830 --> 00:29:34,240

better how it is that that our ultimate

794

00:29:38,830 --> 00:29:35,840

signature of life is going to interact

795

00:29:44,070 --> 00:29:41,750

great well vicki seeing as everyone is

796

00:29:45,190 --> 00:29:44,080

name-checking you let me come back to

797

00:29:49,029 --> 00:29:45,200

you

798

00:29:51,029 --> 00:29:49,039

well where am i going to spend i mean

799

00:29:52,870 --> 00:29:51,039

truly truly embarrassingly large amounts

800

00:29:54,549 --> 00:29:52,880

of money would go on tpf but we don't

801
00:29:55,909 --> 00:29:54,559
have that kind of money so

802
00:29:58,470 --> 00:29:55,919
so again um you know from the

803
00:30:00,870 --> 00:29:58,480
astrobiology perspective i absolutely

804
00:30:02,470 --> 00:30:00,880
agree you know i i put forward this sort

805
00:30:04,070 --> 00:30:02,480
of mean that we need these novel bio

806
00:30:06,310 --> 00:30:04,080
signatures i agree with tori we need to

807
00:30:07,110 --> 00:30:06,320
know about false positives but it's not

808
00:30:08,789 --> 00:30:07,120
just

809
00:30:10,950 --> 00:30:08,799
so that we can interpret the data when

810
00:30:12,149 --> 00:30:10,960
it comes back to to lay that solid

811
00:30:14,070 --> 00:30:12,159
scientific foundation for the

812
00:30:15,190 --> 00:30:14,080
interpretation of our search for life

813
00:30:17,190 --> 00:30:15,200

elsewhere which i think of course is

814

00:30:18,789 --> 00:30:17,200

fundamental to astrobiology but it's

815

00:30:20,789 --> 00:30:18,799

also to drive the design of those

816

00:30:23,029 --> 00:30:20,799

missions as well and i think that must

817

00:30:25,110 --> 00:30:23,039

not be forgotten that sort of the more

818

00:30:26,630 --> 00:30:25,120

we know about the the different types of

819

00:30:28,549 --> 00:30:26,640

things we'll be looking for the better

820

00:30:29,830 --> 00:30:28,559

case we'll have for driving sort of the

821

00:30:31,750 --> 00:30:29,840

requirements whether it be large

822

00:30:33,190 --> 00:30:31,760

spectral wavelengths or high special

823

00:30:35,350 --> 00:30:33,200

resolution or whatever that we will

824

00:30:37,909 --> 00:30:35,360

require to measure these things so i

825

00:30:39,590 --> 00:30:37,919

think that's also crucial as to to know

826

00:30:41,029 --> 00:30:39,600

as much as possible beforehand so we can

827

00:30:43,430 --> 00:30:41,039

build the best possible instruments to

828

00:30:44,310 --> 00:30:43,440

do the measurements

829

00:30:46,149 --> 00:30:44,320

so

830

00:30:47,830 --> 00:30:46,159

in that case in in my mind given very

831

00:30:50,470 --> 00:30:47,840

limited understanding this sort of

832

00:30:53,750 --> 00:30:50,480

segues on perhaps to our last question

833

00:30:56,389 --> 00:30:53,760

then about defining a habitable

834

00:30:57,590 --> 00:30:56,399

environment

835

00:31:00,630 --> 00:30:57,600

so

836

00:31:03,509 --> 00:31:00,640

let me ask you to unmute yourself again

837

00:31:06,389 --> 00:31:03,519

vicky for a moment and just think about

838

00:31:08,230 --> 00:31:06,399

what is it we need to do is it a natural

839

00:31:09,590 --> 00:31:08,240

segue from what you said in order to be

840

00:31:11,269 --> 00:31:09,600

able to define

841

00:31:13,590 --> 00:31:11,279

research and define the habitable

842

00:31:15,110 --> 00:31:13,600

environments

843

00:31:17,830 --> 00:31:15,120

yeah that's that's certainly part of it

844

00:31:19,590 --> 00:31:17,840

it falls into um this idea of being able

845

00:31:21,269 --> 00:31:19,600

to look at something and in my case

846

00:31:23,029 --> 00:31:21,279

again i'll speak for extrasolar planets

847

00:31:24,470 --> 00:31:23,039

but this is true of remote sensing of

848

00:31:28,070 --> 00:31:24,480

anybody in the solar system including

849

00:31:29,830 --> 00:31:28,080

icy moons or mars but being able to to

850

00:31:31,990 --> 00:31:29,840

get information from an environment and

851
00:31:34,230 --> 00:31:32,000
determine whether or not it is habitable

852
00:31:35,669 --> 00:31:34,240
and i think uh you know first off you

853
00:31:38,149 --> 00:31:35,679
know back to the biology we need to

854
00:31:39,430 --> 00:31:38,159
understand life's limitations um and we

855
00:31:41,350 --> 00:31:39,440
need to understand not only life's

856
00:31:43,110 --> 00:31:41,360
limitations but in the case of

857
00:31:45,269 --> 00:31:43,120
exoplanets or different environments how

858
00:31:46,470 --> 00:31:45,279
those limitations might be affected by

859
00:31:48,710 --> 00:31:46,480
by that environment

860
00:31:50,470 --> 00:31:48,720
so a specific example for example is you

861
00:31:52,149 --> 00:31:50,480
know how far can we go with oxygenic

862
00:31:54,389 --> 00:31:52,159
photosynthesis as far as the wavelength

863
00:31:56,310 --> 00:31:54,399

of light that's required and and how

864

00:31:59,029 --> 00:31:56,320

would that light environment change on a

865

00:32:00,310 --> 00:31:59,039

planet around another star um but this

866

00:32:02,070 --> 00:32:00,320

this question sort of feeds into the

867

00:32:03,669 --> 00:32:02,080

main issue which is an improved

868

00:32:05,509 --> 00:32:03,679

understanding of the interaction between

869

00:32:07,909 --> 00:32:05,519

planetary characteristics you know what

870

00:32:09,110 --> 00:32:07,919

the planets like stellar characteristics

871

00:32:10,870 --> 00:32:09,120

what the stars like and how that

872

00:32:12,950 --> 00:32:10,880

interacts with the planet and then the

873

00:32:14,470 --> 00:32:12,960

interaction of other objects in the

874

00:32:17,350 --> 00:32:14,480

planetary system

875

00:32:19,269 --> 00:32:17,360

so for us habitability is really a huge

876

00:32:21,509 --> 00:32:19,279

field where we're trying to

877

00:32:23,430 --> 00:32:21,519

sort of um get beyond the classical

878

00:32:25,509 --> 00:32:23,440

habitable zone and understand which is

879

00:32:27,350 --> 00:32:25,519

which is a great formalism to start with

880

00:32:30,389 --> 00:32:27,360

but to understand all the different

881

00:32:32,870 --> 00:32:30,399

factors that now affect that um

882

00:32:34,549 --> 00:32:32,880

and so in that sense if we if we know

883

00:32:36,389 --> 00:32:34,559

where the habitable zone is or can

884

00:32:38,789 --> 00:32:36,399

constrain it for the highest probability

885

00:32:40,950 --> 00:32:38,799

then that allows us to target the sort

886

00:32:42,230 --> 00:32:40,960

of planets that we want to search for

887

00:32:44,389 --> 00:32:42,240

and the sort of planets that we want to

888

00:32:45,669 --> 00:32:44,399

follow up with with instrumentation

889

00:32:48,070 --> 00:32:45,679

because those observations are going to

890

00:32:49,909 --> 00:32:48,080

be extremely expensive so so in summary

891

00:32:51,350 --> 00:32:49,919

i need to understand limitations i need

892

00:32:53,830 --> 00:32:51,360

to understand the interplay of all the

893

00:32:55,430 --> 00:32:53,840

components that go towards habitability

894

00:32:57,269 --> 00:32:55,440

i need to get that habitable zone

895

00:32:59,350 --> 00:32:57,279

defined so i know where to look and i

896

00:33:02,470 --> 00:32:59,360

know how to prioritize my targets to to

897

00:33:04,149 --> 00:33:02,480

look more at

898

00:33:06,630 --> 00:33:04,159

thank you and i'm just going to ask you

899

00:33:10,149 --> 00:33:06,640

to define one term because i noticed it

900

00:33:11,909 --> 00:33:10,159

popped up in the chat window tpf

901
00:33:14,630 --> 00:33:11,919
oh yes sorry so that's terrestrial

902
00:33:17,430 --> 00:33:14,640
planet finder it's a sort of flagship

903
00:33:19,509 --> 00:33:17,440
mission class uh probably even larger if

904
00:33:21,269 --> 00:33:19,519
there is such a thing uh mission that

905
00:33:22,950 --> 00:33:21,279
will be a very very large telescope that

906
00:33:24,710 --> 00:33:22,960
will allow us to get spectra of

907
00:33:27,029 --> 00:33:24,720
extrasolar planets orbiting around other

908
00:33:29,110 --> 00:33:27,039
stars and therefore allow us to directly

909
00:33:30,870 --> 00:33:29,120
um sample and study their environments

910
00:33:32,789 --> 00:33:30,880
remotely

911
00:33:34,389 --> 00:33:32,799
brilliant thank you

912
00:33:37,110 --> 00:33:34,399
sounds like the sort of thing one might

913
00:33:38,950 --> 00:33:37,120

spend money on large amounts sorry

914

00:33:40,389 --> 00:33:38,960

back to this question about the research

915

00:33:42,789 --> 00:33:40,399

that needs to be done to define

916

00:33:44,870 --> 00:33:42,799

inhabitable environments

917

00:33:47,110 --> 00:33:44,880

yeah i guess i would toss out two things

918

00:33:50,470 --> 00:33:47,120

in regard to this question and the first

919

00:33:51,590 --> 00:33:50,480

is i think that uh we can and should do

920

00:33:53,590 --> 00:33:51,600

more

921

00:33:55,269 --> 00:33:53,600

in order to understand when when we look

922

00:33:57,669 --> 00:33:55,279

at life on earth and take it as an

923

00:33:59,909 --> 00:33:57,679

example or a basis for for defining

924

00:34:01,830 --> 00:33:59,919

habitability i think we should do a

925

00:34:03,430 --> 00:34:01,840

better job of understanding which of the

926

00:34:05,190 --> 00:34:03,440

features the limitations the

927

00:34:07,110 --> 00:34:05,200

capabilities we're seeing

928

00:34:09,030 --> 00:34:07,120

relate to core properties of life and

929

00:34:10,950 --> 00:34:09,040

which are specific choices of our kind

930

00:34:12,710 --> 00:34:10,960

of life and our kind of biochemistry so

931

00:34:14,710 --> 00:34:12,720

in other words i think we should make

932

00:34:16,550 --> 00:34:14,720

the best use of the example we have by

933

00:34:19,190 --> 00:34:16,560

saying you know characteristics a b and

934

00:34:20,790 --> 00:34:19,200

c we can expect to be fairly universal

935

00:34:22,790 --> 00:34:20,800

for whatever reason

936

00:34:24,629 --> 00:34:22,800

but these other features of life are are

937

00:34:27,190 --> 00:34:24,639

such specific choices that that we

938

00:34:28,790 --> 00:34:27,200

really shouldn't feel too tied to them

939

00:34:31,510 --> 00:34:28,800

as we try to understand habitability

940

00:34:34,069 --> 00:34:31,520

elsewhere so i think defining better

941

00:34:36,149 --> 00:34:34,079

what is a core set of features for life

942

00:34:38,149 --> 00:34:36,159

in order to understand and define what

943

00:34:39,909 --> 00:34:38,159

is core habitability

944

00:34:43,190 --> 00:34:39,919

important the other thing that i would

945

00:34:45,030 --> 00:34:43,200

point to is i think that habitability um

946

00:34:47,030 --> 00:34:45,040

at least as it's been defined on paper

947

00:34:48,470 --> 00:34:47,040

has been largely a sort of binary

948

00:34:50,950 --> 00:34:48,480

concept either an environment is

949

00:34:53,349 --> 00:34:50,960

habitable or it's not

950

00:34:55,990 --> 00:34:53,359

in the happy event that that we're

951
00:34:58,390 --> 00:34:56,000
presented with a number of targets for

952
00:35:00,230 --> 00:34:58,400
conservation

953
00:35:02,710 --> 00:35:00,240
any of which might conceivably be called

954
00:35:04,710 --> 00:35:02,720
habitable in a binary sense life could

955
00:35:06,790 --> 00:35:04,720
conceivably exist there how do you

956
00:35:08,390 --> 00:35:06,800
prioritize among them how do you say

957
00:35:09,990 --> 00:35:08,400
that one environment is more habitable

958
00:35:12,150 --> 00:35:10,000
than another represents a better choice

959
00:35:13,349 --> 00:35:12,160
for observation may have a better signal

960
00:35:15,349 --> 00:35:13,359
to noise

961
00:35:17,670 --> 00:35:15,359
when you ultimately go looking and

962
00:35:19,270 --> 00:35:17,680
that's something that that i think maybe

963
00:35:21,430 --> 00:35:19,280

we all have notions about but that we

964

00:35:23,190 --> 00:35:21,440

haven't really tackled in a very

965

00:35:24,550 --> 00:35:23,200

concrete way yet

966

00:35:26,870 --> 00:35:24,560

so those would be the two things that i

967

00:35:30,870 --> 00:35:26,880

i think represent areas for progress at

968

00:35:34,630 --> 00:35:30,880

least when we talk about habitability

969

00:35:34,640 --> 00:35:37,510

yep

970

00:35:40,630 --> 00:35:38,630

thoughts on

971

00:35:44,790 --> 00:35:40,640

defining the research that we need to

972

00:35:49,349 --> 00:35:44,800

define habitable environments

973

00:35:54,310 --> 00:35:51,990

yeah let me think i think we

974

00:35:55,990 --> 00:35:54,320

we need to

975

00:35:58,390 --> 00:35:56,000

be careful here you know in the past

976
00:35:59,829 --> 00:35:58,400
we've been rather comfortable

977
00:36:01,990 --> 00:35:59,839
we've been rather

978
00:36:04,310 --> 00:36:02,000
comfortable to stay within our

979
00:36:06,550 --> 00:36:04,320
our comfort zone defined by

980
00:36:09,030 --> 00:36:06,560
by life on earth and we push that

981
00:36:11,829 --> 00:36:09,040
boundary to extreme environments and

982
00:36:14,470 --> 00:36:11,839
and we should continue to do that

983
00:36:16,710 --> 00:36:14,480
deep subsurface and high temperature and

984
00:36:18,870 --> 00:36:16,720
cold temperature

985
00:36:21,030 --> 00:36:18,880
alkaline and acidic and all the various

986
00:36:21,990 --> 00:36:21,040
various ways to approach that problem

987
00:36:23,670 --> 00:36:22,000
but

988
00:36:26,390 --> 00:36:23,680

you know since this topic

989

00:36:28,630 --> 00:36:26,400

this particular week is devoted to ex

990

00:36:29,910 --> 00:36:28,640

solar system exploration or systems

991

00:36:31,829 --> 00:36:29,920

exploration

992

00:36:34,230 --> 00:36:31,839

i think that you know we need to also

993

00:36:36,150 --> 00:36:34,240

recognize that that um

994

00:36:37,510 --> 00:36:36,160

we need to push that comfort zone beyond

995

00:36:38,950 --> 00:36:37,520

what ever

996

00:36:40,550 --> 00:36:38,960

occurred on earth

997

00:36:43,190 --> 00:36:40,560

to to what didn't occur on earth but

998

00:36:45,109 --> 00:36:43,200

could have occurred elsewhere um

999

00:36:46,790 --> 00:36:45,119

and so that's going to going to mean

1000

00:36:48,310 --> 00:36:46,800

that we need to spend a little more time

1001

00:36:51,030 --> 00:36:48,320

on on

1002

00:36:53,670 --> 00:36:51,040

what sometimes it's called weird life um

1003

00:36:55,430 --> 00:36:53,680

different solvents and

1004

00:36:57,030 --> 00:36:55,440

and different ways that life might have

1005

00:36:58,470 --> 00:36:57,040

formed when you start to talk about

1006

00:36:59,750 --> 00:36:58,480

about uh plants

1007

00:37:03,190 --> 00:36:59,760

and moons that are very different than

1008

00:37:06,310 --> 00:37:03,990

okay

1009

00:37:08,870 --> 00:37:06,320

thank you kelsey anything you want to

1010

00:37:11,190 --> 00:37:08,880

add on this well yeah it's kind of

1011

00:37:13,430 --> 00:37:11,200

similar to um my answer to

1012

00:37:15,910 --> 00:37:13,440

what was the last question but um yeah i

1013

00:37:17,829 --> 00:37:15,920

was thinking very similar to uh sort of

1014

00:37:20,230 --> 00:37:17,839

what other people said there's the two

1015

00:37:22,230 --> 00:37:20,240

aspects being like what you know besides

1016

00:37:23,910 --> 00:37:22,240

life as we know it what are the extremes

1017

00:37:26,230 --> 00:37:23,920

and that's really helpful for other

1018

00:37:27,990 --> 00:37:26,240

places in the solar system uh but also

1019

00:37:29,670 --> 00:37:28,000

understanding the other places

1020

00:37:30,950 --> 00:37:29,680

so it just to me it's the same as

1021

00:37:33,589 --> 00:37:30,960

everyone has said there's kind of those

1022

00:37:36,310 --> 00:37:33,599

two coming at it from both directions

1023

00:37:41,109 --> 00:37:36,320

the environment elsewhere and also what

1024

00:37:47,589 --> 00:37:43,910

oh sorry

1025

00:37:50,870 --> 00:37:47,599

oh there's a slight video lag there um

1026

00:37:52,950 --> 00:37:50,880

let me in that case just uh just direct

1027

00:37:54,790 --> 00:37:52,960

your attention i'm hoping all of our

1028

00:37:57,190 --> 00:37:54,800

panelists can see the little panel

1029

00:37:59,109 --> 00:37:57,200

called live notes too

1030

00:38:02,870 --> 00:37:59,119

because what we've been talking stavros

1031

00:38:04,710 --> 00:38:02,880

has been culling from the the chat room

1032

00:38:05,750 --> 00:38:04,720

um and it seems as though there are

1033

00:38:08,870 --> 00:38:05,760

there are several people who are

1034

00:38:09,990 --> 00:38:08,880

interested in places other than icy

1035

00:38:10,950 --> 00:38:10,000

moons

1036

00:38:13,510 --> 00:38:10,960

um

1037

00:38:16,310 --> 00:38:13,520

and i was curious ah

1038

00:38:17,589 --> 00:38:16,320

are extreme environments on earth

1039

00:38:20,390 --> 00:38:17,599

or mars

1040

00:38:23,430 --> 00:38:20,400

are they equally useful for us or

1041

00:38:26,790 --> 00:38:23,440

in order to understand habitability and

1042

00:38:28,230 --> 00:38:26,800

the identifying extraterrestrial life

1043

00:38:29,510 --> 00:38:28,240

sorry chris

1044

00:38:31,030 --> 00:38:29,520

yeah i think you know i noticed that

1045

00:38:33,109 --> 00:38:31,040

comment and you know if you if you look

1046

00:38:34,550 --> 00:38:33,119

at our the the

1047

00:38:36,950 --> 00:38:34,560

the research that the people on the

1048

00:38:39,190 --> 00:38:36,960

panel do i think that really

1049

00:38:40,390 --> 00:38:39,200

it's it's actually balanced and tori

1050

00:38:42,630 --> 00:38:40,400

tori and i

1051

00:38:43,829 --> 00:38:42,640

uh work on on microbial life and you

1052

00:38:46,550 --> 00:38:43,839

know extreme environments and weird

1053

00:38:49,430 --> 00:38:46,560

metabolisms and weird places on earth

1054

00:38:51,270 --> 00:38:49,440

that is really very um

1055

00:38:53,910 --> 00:38:51,280

focused on planets

1056

00:38:55,190 --> 00:38:53,920

um where kelsey and victoria

1057

00:38:58,150 --> 00:38:55,200

um

1058

00:39:00,870 --> 00:38:58,160

are more on icy icy moons and exoplanets

1059

00:39:02,069 --> 00:39:00,880

respectively so so you know i i'm sorry

1060

00:39:03,109 --> 00:39:02,079

that it came across that way but

1061

00:39:05,589 --> 00:39:03,119

certainly that was the flow of the

1062

00:39:08,069 --> 00:39:05,599

discussion not necessarily the bias of

1063

00:39:09,910 --> 00:39:08,079

the panel and hopefully as we open this

1064

00:39:12,150 --> 00:39:09,920

up for the next 30 minutes

1065

00:39:14,069 --> 00:39:12,160

we can have a lot of discussion about

1066

00:39:16,150 --> 00:39:14,079

about solar system targets other than

1067

00:39:18,550 --> 00:39:16,160

icy moons and exoplanets uh certainly

1068

00:39:20,950 --> 00:39:18,560

the mars program um

1069

00:39:24,630 --> 00:39:20,960

it should be discussed as well as well

1070

00:39:30,390 --> 00:39:27,750

so that seems like a good segway to open

1071

00:39:31,349 --> 00:39:30,400

it up now um

1072

00:39:33,109 --> 00:39:31,359

mike

1073

00:39:36,069 --> 00:39:33,119

we might need your help here i know

1074

00:39:37,430 --> 00:39:36,079

people can raise their hands

1075

00:39:39,750 --> 00:39:37,440

do you then

1076

00:39:42,790 --> 00:39:39,760

turn on their mics what seems to work

1077

00:39:44,470 --> 00:39:42,800

best as our approach here so um all the

1078

00:39:45,829 --> 00:39:44,480

mics are open but if you want to do the

1079

00:39:47,430 --> 00:39:45,839

raised hand

1080

00:39:48,790 --> 00:39:47,440

as a form of protocol just so people

1081

00:39:50,069 --> 00:39:48,800

don't talk over each other that could be

1082

00:39:51,670 --> 00:39:50,079

helpful

1083

00:39:53,430 --> 00:39:51,680

so if people want to do that there's an

1084

00:39:54,630 --> 00:39:53,440

icon at the top of your screen with the

1085

00:39:55,430 --> 00:39:54,640

person who looks like they're raising

1086

00:39:56,950 --> 00:39:55,440

their

1087

00:39:58,790 --> 00:39:56,960

if you click that and say raise hand

1088

00:40:01,670 --> 00:39:58,800

will know that you want to speak up and

1089

00:40:07,109 --> 00:40:04,470

so likes are now open

1090

00:40:10,550 --> 00:40:07,119

wayne first in there like a shot go

1091

00:40:14,950 --> 00:40:12,790

all right can you hear me

1092

00:40:17,750 --> 00:40:14,960

yes we can

1093

00:40:20,150 --> 00:40:17,760

okay very good um

1094

00:40:22,870 --> 00:40:20,160

yeah i was kind of the one that threw in

1095

00:40:25,910 --> 00:40:22,880

the comment about uh possible skewing of

1096

00:40:29,109 --> 00:40:25,920

the panel and i i don't i didn't mean to

1097

00:40:31,430 --> 00:40:29,119

offend anybody i i just wanted to uh

1098

00:40:33,270 --> 00:40:31,440

bring the discussion a little back

1099

00:40:36,069 --> 00:40:33,280

towards something that we have quite a

1100

00:40:36,829 --> 00:40:36,079

bit more ground truth for um

1101

00:40:39,510 --> 00:40:36,839

you know

1102

00:40:43,109 --> 00:40:39,520

exoplanets it's a lot of observation

1103

00:40:46,550 --> 00:40:43,119

from a distance um icy icy moons we have

1104

00:40:48,630 --> 00:40:46,560

some physical and chemical data but

1105

00:40:52,230 --> 00:40:48,640

obviously landing and sampling would

1106

00:40:54,069 --> 00:40:52,240

give us a lot more data than we have

1107

00:40:56,870 --> 00:40:54,079

but at the moment we have quite a bit of

1108

00:40:59,430 --> 00:40:56,880

ground data from mars from

1109

00:41:02,309 --> 00:40:59,440

sampling of the environment not only the

1110

00:41:04,230 --> 00:41:02,319

atmospheric environment and the physical

1111

00:41:05,750 --> 00:41:04,240

temperature radiation environment but

1112

00:41:08,230 --> 00:41:05,760

also quite a bit of

1113

00:41:09,510 --> 00:41:08,240

data about the soil and the regolith

1114

00:41:11,430 --> 00:41:09,520

itself

1115

00:41:15,430 --> 00:41:11,440

and

1116

00:41:17,510 --> 00:41:15,440

this is something that we can take

1117

00:41:19,349 --> 00:41:17,520

right into the laboratory

1118

00:41:22,790 --> 00:41:19,359

and look for

1119

00:41:24,470 --> 00:41:22,800

earth microbes which which can grow and

1120

00:41:25,829 --> 00:41:24,480

survive under those conditions and we

1121

00:41:27,750 --> 00:41:25,839

can actually

1122

00:41:30,710 --> 00:41:27,760

physically test

1123

00:41:33,030 --> 00:41:30,720

the attributes of microbial life that

1124

00:41:35,589 --> 00:41:33,040

allows them to grow in a very close

1125

00:41:36,470 --> 00:41:35,599

simulation of the martian environment

1126

00:41:38,790 --> 00:41:36,480

and

1127

00:41:41,270 --> 00:41:38,800

you know when you compare that with

1128

00:41:43,510 --> 00:41:41,280

the wealth of data we have about what's

1129

00:41:45,510 --> 00:41:43,520

underneath the surface of an icy moon or

1130

00:41:49,270 --> 00:41:45,520

what's circling a star several light

1131

00:41:51,589 --> 00:41:49,280

years away there's no comparison

1132

00:41:53,910 --> 00:41:51,599

and we're really making some some really

1133

00:41:57,030 --> 00:41:53,920

interesting strides in

1134

00:41:58,790 --> 00:41:57,040

defining what it is about a microbial

1135

00:42:01,750 --> 00:41:58,800

cell that allows it to grow at low

1136

00:42:03,829 --> 00:42:01,760

pressure or extreme low temperature

1137

00:42:05,349 --> 00:42:03,839

or in the presence of radiation or

1138

00:42:08,230 --> 00:42:05,359

strong oxidants

1139

00:42:10,309 --> 00:42:08,240

and so i wouldn't

1140

00:42:11,829 --> 00:42:10,319

i wouldn't rule out mars as somebody

1141

00:42:14,230 --> 00:42:11,839

somewhere where we've just been there

1142

00:42:15,750 --> 00:42:14,240

and done that and move on

1143

00:42:19,430 --> 00:42:15,760

i guess that's my

1144

00:42:19,440 --> 00:42:25,270

anyone want to comment on that

1145

00:42:30,550 --> 00:42:28,150

no i completely agree

1146

00:42:32,309 --> 00:42:30,560

i mean i completely agree and and uh

1147

00:42:33,670 --> 00:42:32,319

we're we're at mars we're at mars with

1148

00:42:35,829 --> 00:42:33,680

two rovers and we're going to be going

1149

00:42:38,069 --> 00:42:35,839

to mars with another rover and so

1150

00:42:40,230 --> 00:42:38,079

there's no question that uh

1151

00:42:41,990 --> 00:42:40,240

that in the short term and the medium

1152

00:42:43,829 --> 00:42:42,000

turn a lot of effort and astrobiology

1153

00:42:46,390 --> 00:42:43,839

needs to be geared toward

1154

00:42:49,030 --> 00:42:46,400

toward that particular planetary setting

1155

00:42:53,270 --> 00:42:49,040

and and that should be both for present

1156

00:42:55,430 --> 00:42:53,280

life on mars at near the surface and

1157

00:43:00,069 --> 00:42:55,440

more deeply buried life and also past

1158

00:43:06,230 --> 00:43:03,510

i i'm conscious of time so

1159

00:43:08,710 --> 00:43:06,240

at this point i'd like to ask um kenda

1160

00:43:10,390 --> 00:43:08,720

kendall lynch

1161

00:43:12,069 --> 00:43:10,400

you're mike yes i'm here can everybody

1162

00:43:13,589 --> 00:43:12,079

hear me

1163

00:43:16,470 --> 00:43:13,599

yes we can

1164

00:43:18,150 --> 00:43:16,480

great so i just wanted to address um a

1165

00:43:20,150 --> 00:43:18,160

statement that corey

1166

00:43:21,589 --> 00:43:20,160

kind of um and tori's comments about

1167

00:43:23,510 --> 00:43:21,599

habitability

1168

00:43:25,030 --> 00:43:23,520

and you know it being binary or not and

1169

00:43:26,550 --> 00:43:25,040

how do we start to prioritize because

1170

00:43:29,270 --> 00:43:26,560

clearly we have a lot of habitable

1171

00:43:30,470 --> 00:43:29,280

environments but given our known budget

1172

00:43:33,109 --> 00:43:30,480

constraints

1173

00:43:34,950 --> 00:43:33,119

um that we have and will continue to

1174

00:43:37,430 --> 00:43:34,960

have in the foreseeable future we do

1175

00:43:39,430 --> 00:43:37,440

need to prioritize and one of the things

1176

00:43:41,349 --> 00:43:39,440

that i see that we need to do more it's

1177

00:43:43,270 --> 00:43:41,359

not necessarily

1178

00:43:46,470 --> 00:43:43,280

a specific touch of a new direction of

1179

00:43:48,069 --> 00:43:46,480

research but i think it's in

1180

00:43:50,470 --> 00:43:48,079

considerating the connectivity of the

1181

00:43:52,150 --> 00:43:50,480

work that we have done and the context

1182

00:43:54,069 --> 00:43:52,160

of the environments that we've studied

1183

00:43:55,910 --> 00:43:54,079

here on earth and how they are applied

1184

00:43:58,309 --> 00:43:55,920

to

1185

00:43:59,910 --> 00:43:58,319

these other planetary environments so we

1186

00:44:02,069 --> 00:43:59,920

need to understand not only okay is an

1187

00:44:03,670 --> 00:44:02,079

environment habitable habitable

1188

00:44:05,510 --> 00:44:03,680

can it produce biosignatures but what is

1189

00:44:07,589 --> 00:44:05,520

the connectivity between it being

1190

00:44:09,270 --> 00:44:07,599

habitable both in the past and in the

1191

00:44:11,990 --> 00:44:09,280

present what is that connectivity to the

1192

00:44:13,750 --> 00:44:12,000

possibility of life originating in that

1193

00:44:15,829 --> 00:44:13,760

potential habitable environment what is

1194

00:44:17,589 --> 00:44:15,839

the what is the connectivity to that

1195

00:44:20,230 --> 00:44:17,599

environment being accessible with our

1196

00:44:22,710 --> 00:44:20,240

mission goals we need to create this

1197

00:44:24,150 --> 00:44:22,720

connectivity between these habitable

1198

00:44:26,390 --> 00:44:24,160

between these different aspects of each

1199

00:44:28,069 --> 00:44:26,400

habitable environment in that way we

1200

00:44:30,390 --> 00:44:28,079

should be able to develop a way to

1201
00:44:32,309 --> 00:44:30,400
prioritize which environments do we want

1202
00:44:33,349 --> 00:44:32,319
to target for study with our given our

1203
00:44:34,950 --> 00:44:33,359
limited

1204
00:44:36,550 --> 00:44:34,960
mission resources so that's something

1205
00:44:39,990 --> 00:44:36,560
that i think

1206
00:44:42,230 --> 00:44:40,000
astrobiologists can um participate

1207
00:44:43,670 --> 00:44:42,240
more in on the mission front because for

1208
00:44:45,109 --> 00:44:43,680
example i was just at an early mars

1209
00:44:46,630 --> 00:44:45,119
meeting and all of the mission people

1210
00:44:48,069 --> 00:44:46,640
who were almost all pure geologists or

1211
00:44:50,390 --> 00:44:48,079
planetary scientists there was a group

1212
00:44:52,390 --> 00:44:50,400
of astrobiologists there and when they

1213
00:44:54,309 --> 00:44:52,400

said hey astrobiologists where should we

1214

00:44:55,430 --> 00:44:54,319

look the answer was all over the place

1215

00:44:56,710 --> 00:44:55,440

there was no

1216

00:44:58,870 --> 00:44:56,720

coordinated

1217

00:45:00,630 --> 00:44:58,880

focused considered

1218

00:45:01,910 --> 00:45:00,640

metric of how to

1219

00:45:03,349 --> 00:45:01,920

answer that question and i think that's

1220

00:45:07,190 --> 00:45:03,359

something that we as the astrobiology

1221

00:45:09,270 --> 00:45:07,200

community need to focus on in this next

1222

00:45:11,430 --> 00:45:09,280

um in this next roadmap to make sure

1223

00:45:14,309 --> 00:45:11,440

that we can get our voices heard for our

1224

00:45:14,319 --> 00:45:17,349

i'm done

1225

00:45:21,589 --> 00:45:20,710

do you want to add anything to that

1226

00:45:23,430 --> 00:45:21,599

um

1227

00:45:24,790 --> 00:45:23,440

not so much add to what kenda said it

1228

00:45:27,270 --> 00:45:24,800

just sparked another thought for me

1229

00:45:29,829 --> 00:45:27,280

which is uh you know this this question

1230

00:45:31,670 --> 00:45:29,839

of time inhabitability is something i

1231

00:45:33,510 --> 00:45:31,680

don't think is addressed all that much

1232

00:45:35,510 --> 00:45:33,520

and in particular for me it raises an

1233

00:45:38,150 --> 00:45:35,520

issue that i usually think of it

1234

00:45:39,990 --> 00:45:38,160

uh in reference to extant life how would

1235

00:45:41,750 --> 00:45:40,000

extant life fair if dropped into this

1236

00:45:43,430 --> 00:45:41,760

environment um you know would it

1237

00:45:45,270 --> 00:45:43,440

proliferate would it barely limp along

1238

00:45:46,870 --> 00:45:45,280

but there's a second question that isn't

1239

00:45:48,870 --> 00:45:46,880

addressed quite so often

1240

00:45:50,230 --> 00:45:48,880

um and that is how conducive is an

1241

00:45:52,150 --> 00:45:50,240

environment to having life originated in

1242

00:45:53,190 --> 00:45:52,160

the first place that's a very difficult

1243

00:45:54,790 --> 00:45:53,200

question to answer because i don't think

1244

00:45:57,670 --> 00:45:54,800

we understand how that process happens

1245

00:46:00,309 --> 00:45:57,680

at all but it's a much more restrictive

1246

00:46:02,630 --> 00:46:00,319

set of conditions certainly and and so

1247

00:46:03,510 --> 00:46:02,640

trying to bring some notion of

1248

00:46:05,030 --> 00:46:03,520

time

1249

00:46:06,309 --> 00:46:05,040

and origins into the question of

1250

00:46:13,990 --> 00:46:06,319

habitability

1251
00:46:19,190 --> 00:46:17,349
just uh probably one other question

1252
00:46:21,510 --> 00:46:19,200
murphy and let's see you've got your

1253
00:46:24,790 --> 00:46:21,520
hand up

1254
00:46:26,230 --> 00:46:24,800
yeah this is the motive party jpl um

1255
00:46:28,150 --> 00:46:26,240
i think

1256
00:46:30,790 --> 00:46:28,160
one of the key differences between

1257
00:46:32,150 --> 00:46:30,800
astrobiology and biology is as i said in

1258
00:46:34,550 --> 00:46:32,160
my chart

1259
00:46:37,030 --> 00:46:34,560
uh to

1260
00:46:39,030 --> 00:46:37,040
see how far life

1261
00:46:41,190 --> 00:46:39,040
could have evolved that means the

1262
00:46:43,990 --> 00:46:41,200
prebiotic evolution as well

1263
00:46:47,190 --> 00:46:44,000

uh on other you know solar system

1264

00:46:49,030 --> 00:46:47,200

objects rather than just go and look for

1265

00:46:51,430 --> 00:46:49,040

uh whether it is habitable or whether it

1266

00:46:53,190 --> 00:46:51,440

has life or not like you know binary as

1267

00:46:55,589 --> 00:46:53,200

story was telling

1268

00:46:57,589 --> 00:46:55,599

and for that reason i think we need to

1269

00:46:58,710 --> 00:46:57,599

really focus on

1270

00:47:11,030 --> 00:46:58,720

on

1271

00:47:13,990 --> 00:47:11,040

should also get involved

1272

00:47:16,470 --> 00:47:14,000

in mission supported research but as i

1273

00:47:20,470 --> 00:47:16,480

also mentioned in my chat we should not

1274

00:47:22,230 --> 00:47:20,480

be a sub uh you know ordinate of a

1275

00:47:25,990 --> 00:47:22,240

mission because

1276

00:47:29,270 --> 00:47:26,000

uh then the independence of uh the

1277

00:47:30,870 --> 00:47:29,280

astrobiology uh you know uh research

1278

00:47:33,670 --> 00:47:30,880

will be gone

1279

00:47:37,190 --> 00:47:33,680

so though we as kendra said just now

1280

00:47:39,190 --> 00:47:37,200

that uh the the mars uh you know uh

1281

00:47:43,109 --> 00:47:39,200

community needs to know what

1282

00:47:45,589 --> 00:47:43,119

astrobiology is offering them

1283

00:47:47,030 --> 00:47:45,599

we should not become a subject of uh

1284

00:47:49,109 --> 00:47:47,040

mars uh

1285

00:47:50,630 --> 00:47:49,119

you know biological potential and things

1286

00:47:53,910 --> 00:47:50,640

like that so we should keep our

1287

00:47:56,150 --> 00:47:53,920

independence and

1288

00:47:59,349 --> 00:47:56,160

connect with the missions but our goal

1289

00:48:00,150 --> 00:47:59,359

should be actually finding the mission

1290

00:48:02,790 --> 00:48:00,160

of

1291

00:48:05,190 --> 00:48:02,800

nai as well as nasa

1292

00:48:08,870 --> 00:48:05,200

that is you know how far life has come

1293

00:48:11,750 --> 00:48:08,880

elsewhere and how can we detect it

1294

00:48:13,910 --> 00:48:13,030

thank you

1295

00:48:15,670 --> 00:48:13,920

um

1296

00:48:18,470 --> 00:48:15,680

okay it doesn't look as though anyone

1297

00:48:21,349 --> 00:48:18,480

else has their hand up at the moment i'm

1298

00:48:24,069 --> 00:48:21,359

just scrolling through my list here um

1299

00:48:26,069 --> 00:48:24,079

let me just ask the participants on on

1300

00:48:29,589 --> 00:48:26,079

the call out there

1301
00:48:32,309 --> 00:48:29,599
does anyone want to um advocate for a

1302
00:48:34,069 --> 00:48:32,319
particular area of research i'm thinking

1303
00:48:36,390 --> 00:48:34,079
particularly about the second question

1304
00:48:39,510 --> 00:48:36,400
about determine the set of criteria for

1305
00:48:41,910 --> 00:48:39,520
identifying extraterrestrial life um

1306
00:48:44,230 --> 00:48:41,920
and of course the third question as well

1307
00:48:46,309 --> 00:48:44,240
there's sort of a lot of chat i've seen

1308
00:48:50,630 --> 00:48:46,319
in the chat room does anyone want to

1309
00:48:57,910 --> 00:48:50,640
expand upon what they've said um for the

1310
00:49:03,030 --> 00:49:00,230
yeah let me let me say something so ron

1311
00:49:05,109 --> 00:49:03,040
breslow i give you am i in there or do i

1312
00:49:07,270 --> 00:49:05,119
have to press some button in order to

1313
00:49:08,710 --> 00:49:07,280

be heard you you are in you are alive

1314

00:49:10,630 --> 00:49:08,720

and direct

1315

00:49:12,309 --> 00:49:10,640

okay yeah yeah there's there's another

1316

00:49:14,630 --> 00:49:12,319

there's another part of this which is

1317

00:49:16,470 --> 00:49:14,640

fact supported by the astrobiology

1318

00:49:17,430 --> 00:49:16,480

system and which i think is quite

1319

00:49:19,589 --> 00:49:17,440

important

1320

00:49:21,430 --> 00:49:19,599

and it's it's a more it's an earlier

1321

00:49:24,150 --> 00:49:21,440

question than anybody has ever asked

1322

00:49:26,230 --> 00:49:24,160

that is how did life start here

1323

00:49:27,750 --> 00:49:26,240

and the question really comes down to

1324

00:49:29,910 --> 00:49:27,760

things like where did you get the

1325

00:49:31,589 --> 00:49:29,920

appropriate chemical environment such

1326

00:49:33,349 --> 00:49:31,599

that the chemicals were there after all

1327

00:49:35,750 --> 00:49:33,359

they can't be produced by my life it

1328

00:49:38,150 --> 00:49:35,760

comes later right so yeah where did we

1329

00:49:41,030 --> 00:49:38,160

get all the chemicals and the most most

1330

00:49:42,069 --> 00:49:41,040

curious one about our chemicals is that

1331

00:49:43,910 --> 00:49:42,079

we have

1332

00:49:46,390 --> 00:49:43,920

selective chirality and all these

1333

00:49:48,870 --> 00:49:46,400

chemicals the amino acids are what are

1334

00:49:51,589 --> 00:49:48,880

called l amino acids like your left hand

1335

00:49:53,589 --> 00:49:51,599

and the sugars are d amino d sugars like

1336

00:49:55,510 --> 00:49:53,599

your right hand and yet

1337

00:49:57,990 --> 00:49:55,520

spontaneous chemistry without life

1338

00:49:59,910 --> 00:49:58,000

around to direct it doesn't lead to that

1339

00:50:02,150 --> 00:49:59,920

kind of thing so where did he come from

1340

00:50:03,829 --> 00:50:02,160

and that's where a very exciting new

1341

00:50:06,470 --> 00:50:03,839

thing which has happened has really

1342

00:50:08,390 --> 00:50:06,480

opened up this field that is meteorites

1343

00:50:10,950 --> 00:50:08,400

landing here have arrived with some

1344

00:50:12,549 --> 00:50:10,960

excess chirality and people spend their

1345

00:50:14,150 --> 00:50:12,559

time trying to figure out where it came

1346

00:50:16,390 --> 00:50:14,160

from but what we spend our time with is

1347

00:50:18,549 --> 00:50:16,400

saying how does that then steer all the

1348

00:50:20,549 --> 00:50:18,559

chirality on earth so that you get

1349

00:50:23,309 --> 00:50:20,559

the l amino acids you need and the d

1350

00:50:25,589 --> 00:50:23,319

sugars that you need in a sensible

1351
00:50:27,750 --> 00:50:25,599
non-vital way not having nothing to do

1352
00:50:30,390 --> 00:50:27,760
with life but having to do with

1353
00:50:32,230 --> 00:50:30,400
prebiotic life getting getting it ready

1354
00:50:33,670 --> 00:50:32,240
now that means of course that it's a

1355
00:50:35,829 --> 00:50:33,680
good chance that one has to have

1356
00:50:36,950 --> 00:50:35,839
something like that going wherever life

1357
00:50:38,950 --> 00:50:36,960
is going to be it's not going to

1358
00:50:40,710 --> 00:50:38,960
suddenly appear without the chemicals

1359
00:50:41,829 --> 00:50:40,720
that comprise it

1360
00:50:44,390 --> 00:50:41,839
and of course they could be different

1361
00:50:46,870 --> 00:50:44,400
chemicals to mars but still they're very

1362
00:50:49,750 --> 00:50:46,880
unlikely to be flat chemicals which have

1363
00:50:51,990 --> 00:50:49,760

no sense of left or right it's just any

1364

00:50:54,230 --> 00:50:52,000

sensible reasonably reasonable

1365

00:50:55,030 --> 00:50:54,240

reasonable large molecule has that that

1366

00:50:57,510 --> 00:50:55,040

thing

1367

00:50:59,030 --> 00:50:57,520

and so then the question is uh one of

1368

00:51:01,270 --> 00:50:59,040

the things that's quite interesting why

1369

00:51:03,190 --> 00:51:01,280

did we end up with left rather than

1370

00:51:05,190 --> 00:51:03,200

right amino acids why do we end up with

1371

00:51:07,589 --> 00:51:05,200

right other left sugars how did that all

1372

00:51:10,309 --> 00:51:07,599

come about and is it possible that in

1373

00:51:11,750 --> 00:51:10,319

other environments it would be reversed

1374

00:51:13,670 --> 00:51:11,760

so people are quite interested in the

1375

00:51:15,109 --> 00:51:13,680

possibility that life somewhere else

1376

00:51:16,390 --> 00:51:15,119

might be the mirror image of what's

1377

00:51:19,190 --> 00:51:16,400

going on here

1378

00:51:21,349 --> 00:51:19,200

and that even finding that chirality

1379

00:51:23,430 --> 00:51:21,359

somewhere would be really exciting

1380

00:51:26,309 --> 00:51:23,440

because as i say it's not what you get

1381

00:51:29,109 --> 00:51:26,319

spontaneously except for

1382

00:51:31,349 --> 00:51:29,119

this special situation in in meteorites

1383

00:51:33,750 --> 00:51:31,359

landing here which are bringing in

1384

00:51:35,670 --> 00:51:33,760

something that was developed outside of

1385

00:51:36,790 --> 00:51:35,680

our atmosphere by uh

1386

00:51:38,390 --> 00:51:36,800

right probably right circularly

1387

00:51:41,109 --> 00:51:38,400

polarized light but even that hasn't

1388

00:51:42,549 --> 00:51:41,119

been detected and identified yet so this

1389

00:51:44,230 --> 00:51:42,559

is a lot of you know that that has to be

1390

00:51:45,829 --> 00:51:44,240

worked on but what we're doing right now

1391

00:51:47,670 --> 00:51:45,839

is just to try to figure out what

1392

00:51:50,390 --> 00:51:47,680

spontaneous chemistry can make the

1393

00:51:52,309 --> 00:51:50,400

things that are needed for dna and for

1394

00:51:54,230 --> 00:51:52,319

proteins for all the things that at

1395

00:51:56,549 --> 00:51:54,240

least in our version of life are

1396

00:51:59,510 --> 00:51:56,559

critical

1397

00:52:02,150 --> 00:51:59,520

so ron let me ask you in that case

1398

00:52:03,990 --> 00:52:02,160

i shouldn't limit uh the spending the

1399

00:52:06,150 --> 00:52:04,000

very large amounts of money just to the

1400

00:52:08,309 --> 00:52:06,160

panelists where would where would you

1401
00:52:09,589 --> 00:52:08,319
write the check if you wanted to advance

1402
00:52:11,589 --> 00:52:09,599
that

1403
00:52:13,349 --> 00:52:11,599
well i have an idea

1404
00:52:15,750 --> 00:52:13,359
well somebody i i could probably think

1405
00:52:18,309 --> 00:52:15,760
of where you would do it uh the minimum

1406
00:52:20,150 --> 00:52:18,319
thing i would like to do i have a a

1407
00:52:23,349 --> 00:52:20,160
colleague actually who has support from

1408
00:52:24,710 --> 00:52:23,359
nasa uh named amber miller she uh she

1409
00:52:27,190 --> 00:52:24,720
looks at uh

1410
00:52:30,630 --> 00:52:27,200
the light in outside our atmosphere that

1411
00:52:32,069 --> 00:52:30,640
there's a residual of the uh the

1412
00:52:34,230 --> 00:52:32,079
light that was originally emitted during

1413
00:52:36,870 --> 00:52:34,240

the big bang so it's obviously quite far

1414

00:52:39,190 --> 00:52:36,880

back from when life got around but she

1415

00:52:41,589 --> 00:52:39,200

and i would like to send up

1416

00:52:43,349 --> 00:52:41,599

an observer to uh get outside our

1417

00:52:44,870 --> 00:52:43,359

atmosphere and see whether we have in

1418

00:52:46,470 --> 00:52:44,880

fact an excess of right circular

1419

00:52:49,109 --> 00:52:46,480

polarized light which is the one that

1420

00:52:51,670 --> 00:52:49,119

really makes the most sense for why it

1421

00:52:53,510 --> 00:52:51,680

is we we have the chirality we have but

1422

00:52:54,950 --> 00:52:53,520

it's one thing to say that it must be

1423

00:52:56,790 --> 00:52:54,960

there and another thing as you know as a

1424

00:52:58,630 --> 00:52:56,800

scientist to see and sure enough there

1425

00:53:00,549 --> 00:52:58,640

it is so i would like to put it's not a

1426
00:53:02,870 --> 00:53:00,559
huge amount of money but some amount of

1427
00:53:04,710 --> 00:53:02,880
money to get to let us send up what

1428
00:53:06,150 --> 00:53:04,720
amber does she sends up a balloon to the

1429
00:53:08,549 --> 00:53:06,160
edge of the atmosphere and then she can

1430
00:53:10,549 --> 00:53:08,559
pick up the extra extra

1431
00:53:12,950 --> 00:53:10,559
atmospheric light and that's what we

1432
00:53:15,430 --> 00:53:12,960
would like to do modest but not not

1433
00:53:17,990 --> 00:53:15,440
negligible

1434
00:53:19,829 --> 00:53:18,000
excellent thank you

1435
00:53:21,910 --> 00:53:19,839
michael um

1436
00:53:27,190 --> 00:53:21,920
is there anything that you want to to

1437
00:53:31,030 --> 00:53:29,670
no i i

1438
00:53:33,430 --> 00:53:31,040

i think there's been some good

1439

00:53:37,190 --> 00:53:33,440

conversation especially especially in

1440

00:53:39,270 --> 00:53:37,200

the chat window i'm um

1441

00:53:41,190 --> 00:53:39,280

a little bit surprised that nobody's

1442

00:53:43,910 --> 00:53:41,200

jumped forward with their favorite uh

1443

00:53:46,950 --> 00:53:45,109

or

1444

00:53:48,870 --> 00:53:46,960

the discussion of what makes a

1445

00:53:51,430 --> 00:53:48,880

environment habitable

1446

00:53:55,030 --> 00:53:51,440

um since these are great topics usually

1447

00:54:00,150 --> 00:53:56,630

so i would like to know what people

1448

00:54:03,190 --> 00:54:01,430

what do we need to do to define an

1449

00:54:06,710 --> 00:54:03,200

environment as habitable you know we we

1450

00:54:07,670 --> 00:54:06,720

have this basic triad we talked about of

1451

00:54:10,309 --> 00:54:07,680

water

1452

00:54:12,710 --> 00:54:10,319

nutrients and free energy differences

1453

00:54:15,430 --> 00:54:12,720

but beyond that that's pretty other than

1454

00:54:17,430 --> 00:54:15,440

saying water it's pretty high level

1455

00:54:19,349 --> 00:54:17,440

pretty abstract in a way

1456

00:54:21,190 --> 00:54:19,359

so i would be curious to know what what

1457

00:54:27,030 --> 00:54:21,200

people think we need to actually go and

1458

00:54:35,190 --> 00:54:29,990

so it's what do we what do we have to do

1459

00:54:42,470 --> 00:54:37,109

well basically it's your third question

1460

00:54:48,870 --> 00:54:46,309

oh mercy you want to come back on that

1461

00:54:51,109 --> 00:54:48,880

yeah i just wanted to uh you know touch

1462

00:54:53,829 --> 00:54:51,119

upon mike's question but before that i

1463

00:54:56,309 --> 00:54:53,839

want to disambiguate my earlier

1464

00:54:57,270 --> 00:54:56,319

statement is saying that

1465

00:54:59,829 --> 00:54:57,280

the

1466

00:55:03,589 --> 00:54:59,839

astrobiology research should actually

1467

00:55:07,670 --> 00:55:03,599

lead and strengthen the missions and the

1468

00:55:10,630 --> 00:55:07,680

missions needs should be catered

1469

00:55:13,750 --> 00:55:10,640

partly by astrobiology research

1470

00:55:16,069 --> 00:55:13,760

but these two should not be you know

1471

00:55:17,670 --> 00:55:16,079

totally coupled together to lose the

1472

00:55:20,069 --> 00:55:17,680

independence of astrobiology research

1473

00:55:22,390 --> 00:55:20,079

okay that's my statement ellis statement

1474

00:55:24,789 --> 00:55:22,400

now coming back to michael's uh you know

1475

00:55:26,789 --> 00:55:24,799

habitability environments

1476

00:55:30,150 --> 00:55:26,799

uh i think we need to also put a

1477

00:55:33,109 --> 00:55:30,160

qualifier here saying as we

1478

00:55:35,270 --> 00:55:33,119

think of life uh in

1479

00:55:37,750 --> 00:55:35,280

in the context of earth

1480

00:55:39,670 --> 00:55:37,760

so that's a a very important thing once

1481

00:55:43,349 --> 00:55:39,680

we put that qualifier

1482

00:55:44,230 --> 00:55:43,359

then it boils down to uh as mike said a

1483

00:55:48,630 --> 00:55:44,240

few

1484

00:55:51,670 --> 00:55:48,640

key aspects one is the liquid water

1485

00:55:54,150 --> 00:55:51,680

for the mobility and then the nutrients

1486

00:55:55,030 --> 00:55:54,160

and the energy

1487

00:55:55,910 --> 00:55:55,040

and

1488

00:55:57,589 --> 00:55:55,920

the

1489

00:55:59,670 --> 00:55:57,599

electrical

1490

00:56:01,670 --> 00:55:59,680

let's say

1491

00:56:03,190 --> 00:56:01,680

dipole forces that means there should be

1492

00:56:06,230 --> 00:56:03,200

a gradient

1493

00:56:09,030 --> 00:56:06,240

so these are the uh you know

1494

00:56:11,190 --> 00:56:09,040

of course organics of course organics

1495

00:56:13,510 --> 00:56:11,200

without organics uh you know as we think

1496

00:56:16,789 --> 00:56:13,520

of life there is no life so all these

1497

00:56:17,670 --> 00:56:16,799

are the five uh you know key aspects and

1498

00:56:19,829 --> 00:56:17,680

i think

1499

00:56:23,030 --> 00:56:19,839

majority of you know the potentially

1500

00:56:25,109 --> 00:56:23,040

habitable environments on uh in our

1501

00:56:26,309 --> 00:56:25,119

solar system actually qualify for this

1502

00:56:29,510 --> 00:56:26,319

for example

1503

00:56:32,069 --> 00:56:29,520

the subsurface of titan qualifies for us

1504

00:56:34,870 --> 00:56:32,079

and subsurface of europa qualifies for

1505

00:56:37,030 --> 00:56:34,880

this and probably even mars subsurface

1506

00:56:38,549 --> 00:56:37,040

qualifies for this and even probably the

1507

00:56:41,990 --> 00:56:38,559

surface of mars

1508

00:56:43,589 --> 00:56:42,000

would have qualified earlier so i i

1509

00:56:47,190 --> 00:56:43,599

that's my you know take about the

1510

00:56:49,990 --> 00:56:47,200

habitable environments

1511

00:56:52,549 --> 00:56:50,000

thank you and with that we will draw it

1512

00:56:54,950 --> 00:56:52,559

to a close um i would just like to draw

1513

00:56:58,069 --> 00:56:54,960

everyone's attention to the website

1514

00:56:59,910 --> 00:56:58,079

which starburst has just typed up in the

1515

00:57:03,030 --> 00:56:59,920

middle chat window if you're not

1516

00:57:05,190 --> 00:57:03,040

registered on astrobiologyfuture.org

1517

00:57:07,910 --> 00:57:05,200

already please do so

1518

00:57:09,510 --> 00:57:07,920

we are now going to take

1519

00:57:10,309 --> 00:57:09,520

these questions

1520

00:57:12,710 --> 00:57:10,319

and

1521

00:57:15,510 --> 00:57:12,720

encourage you to add others you'll find

1522

00:57:17,750 --> 00:57:15,520

that there is a discussion forum

1523

00:57:20,549 --> 00:57:17,760

um we've popped up a couple of starting

1524

00:57:23,190 --> 00:57:20,559

categories one around interesting ideas

1525

00:57:25,349 --> 00:57:23,200

and the other around exciting questions

1526

00:57:27,270 --> 00:57:25,359

please don't feel constrained by those

1527

00:57:28,309 --> 00:57:27,280

if you want to start other categories do

1528

00:57:29,750 --> 00:57:28,319

so

1529

00:57:32,150 --> 00:57:29,760

but really what we're looking to do is

1530

00:57:34,470 --> 00:57:32,160

over the next week to capture any

1531

00:57:36,230 --> 00:57:34,480

thoughts that you've had as you go out

1532

00:57:37,750 --> 00:57:36,240

walking your dog having the shower and

1533

00:57:38,789 --> 00:57:37,760

you think that's what i should have

1534

00:57:40,390 --> 00:57:38,799

asked them

1535

00:57:43,349 --> 00:57:40,400

please don't lose it put it in the

1536

00:57:45,190 --> 00:57:43,359

discussion forum and that will help to

1537

00:57:46,390 --> 00:57:45,200

drive the process for the road mapping

1538

00:57:48,309 --> 00:57:46,400

activity

1539

00:57:51,510 --> 00:57:48,319

so with that thank you very much to our