



David Des Marais



Steve Vance



Andy Burnett

Attendees (16)

▼ Hosts (1)

Estelle Dodson

▼ Presenters (3)

Andy Burnett

David Des Marais

Steve Vance

▼ Participants (12)

Alex Pavlov

Britney Schmidt

Jen Eigenbrode

John Rummel

Kristina Rojdev

Lindsay Hays

Nancy Kiang

Niki

Patricio Rojo

Pauli Laine

Shawn Domagal-Gold...

Tom Murphy

Open Chat (Everyone)

And what Dave DesMarais says is also true -- finding past life would make one suspicious about the survival of life to the present day.

----- (11/06/2013 11:32) -----

John Rummel: Giving engineers nightmares is not a bad thing.... Sometimes it is required!

----- (11/06/2013 11:33) -----

John Rummel: An additional perspective, tying in elsewhere in the Roadmap: • Is a habitable zone the best place to look for the origin of life? Or are habitable zones the place where life, once formed, is materially and energetically better off, and therefore separate in kind from "origin zones."

Andy Burnett: The document is now open for commenting

Shawn Domagal-Goldman: That's a great line of thought John, and it lies at the intersection of today's seminar and tomorrow's seminar (on exoplanet habitability and biosignatures).

Teleconference Instructions (Parti...

Teleconference Line: 866-692-3158

Passcode: 9109668#

Please use *6 to **MUTE** your phone's mic when not speaking.

More info: <https://astrobiologyfuture.org>

IdentfyHabEnvSolarSys2.pptx

Full Screen

What else?

- Might include perspectives on trends of instrument development in context of needed measurements that may be possible in future
- How do other aspects of solar system exploration affect search for habitable environments? E.g., lunar exploration
- What about human exploration?

1
00:00:13,430 --> 00:00:10,870
welcome to the next in our webinar

2
00:00:16,150 --> 00:00:13,440
series with uh steve and dave who are

3
00:00:18,230 --> 00:00:16,160
going to be uh talking through on how we

4
00:00:20,310 --> 00:00:18,240
identify the habitable habitable

5
00:00:22,150 --> 00:00:20,320
environments in our solar systems easy

6
00:00:25,910 --> 00:00:22,160
for me to say as i say

7
00:00:28,790 --> 00:00:25,920
um just a couple of announcements um

8
00:00:31,990 --> 00:00:28,800
as before the white paper the concept

9
00:00:35,510 --> 00:00:32,000
document uh is currently in read-only

10
00:00:37,110 --> 00:00:35,520
mode and uh that will be flipped over to

11
00:00:38,950 --> 00:00:37,120
comment mode

12
00:00:41,830 --> 00:00:38,960
as soon as the presentations are

13
00:00:44,470 --> 00:00:41,840

finished the other thing is for anyone

14

00:00:45,910 --> 00:00:44,480

who might be listening to this just in

15

00:00:48,470 --> 00:00:45,920

audio

16

00:00:52,069 --> 00:00:48,480

or who comes along and watches this

17

00:00:55,110 --> 00:00:52,079

later the slides for this presentation

18

00:00:57,270 --> 00:00:55,120

can be accessed directly from the event

19

00:01:00,389 --> 00:00:57,280

on the astrobiology

20

00:01:02,549 --> 00:01:00,399

website so you go to today's event click

21

00:01:04,710 --> 00:01:02,559

on that and you'll see a link directly

22

00:01:07,670 --> 00:01:04,720

to the slides on that

23

00:01:10,310 --> 00:01:07,680

and again if you want to go back to any

24

00:01:13,990 --> 00:01:10,320

of the previous webinars each of the

25

00:01:16,070 --> 00:01:14,000

events is now linked to the recording of

26

00:01:17,830 --> 00:01:16,080

the webinars i think we're running one

27

00:01:20,870 --> 00:01:17,840

week behind

28

00:01:21,749 --> 00:01:20,880

but those will all gradually catch up

29

00:01:23,910 --> 00:01:21,759

and

30

00:01:25,670 --> 00:01:23,920

uh the process for today just in case

31

00:01:27,510 --> 00:01:25,680

we've got anyone with us who hasn't been

32

00:01:29,429 --> 00:01:27,520

to one of these before during the

33

00:01:34,310 --> 00:01:29,439

presentation section we're encouraging

34

00:01:35,990 --> 00:01:34,320

everyone to um use the text chat box

35

00:01:37,990 --> 00:01:36,000

if you have any points you want to make

36

00:01:39,749 --> 00:01:38,000

or questions that you want to raise and

37

00:01:42,069 --> 00:01:39,759

the presenters will pick them up as long

38

00:01:44,469 --> 00:01:42,079

as it doesn't derail where they're going

39

00:01:46,310 --> 00:01:44,479

at that time once the presentation is

40

00:01:47,990 --> 00:01:46,320

finished um we'll

41

00:01:50,469 --> 00:01:48,000

be encouraging you to use the phone

42

00:01:52,230 --> 00:01:50,479

lines to ask questions if we have a lot

43

00:01:55,590 --> 00:01:52,240

of people and i see the the room is

44

00:01:57,990 --> 00:01:55,600

gradually filling up then ideally if you

45

00:01:59,910 --> 00:01:58,000

can use the hand raising mechanism which

46

00:02:01,510 --> 00:01:59,920

you'll see i was getting this wrong sort

47

00:02:04,550 --> 00:02:01,520

of up at the top of the screen that way

48

00:02:07,190 --> 00:02:04,560

if you notice as i click on it um it

49

00:02:09,669 --> 00:02:07,200

raises the hand next to my name and that

50

00:02:12,550 --> 00:02:09,679

just lets us call you off in order and

51
00:02:15,589 --> 00:02:12,560
keep keep some semblance of order around

52
00:02:17,830 --> 00:02:15,599
the way we go okay and with that i will

53
00:02:19,350 --> 00:02:17,840
pass over to steve

54
00:02:20,710 --> 00:02:19,360
all right thanks everyone for joining

55
00:02:21,750 --> 00:02:20,720
this discussion

56
00:02:24,710 --> 00:02:21,760
um

57
00:02:28,229 --> 00:02:24,720
dave and i will try to present uh this

58
00:02:31,030 --> 00:02:28,239
subset of a larger discussion um

59
00:02:34,470 --> 00:02:31,040
and uh lots of lots of time for disc for

60
00:02:36,949 --> 00:02:34,480
conversation at the end uh so this

61
00:02:38,550 --> 00:02:36,959
specific topic is how can we identify

62
00:02:40,869 --> 00:02:38,560
habitable environments in our solar

63
00:02:43,350 --> 00:02:40,879

system and we're viewing this as

64

00:02:46,309 --> 00:02:43,360
encompassing a lot of planetary

65

00:02:48,869 --> 00:02:46,319
exploration uh in general and

66

00:02:52,390 --> 00:02:48,879
i'll just give a reminder of some of the

67

00:02:53,750 --> 00:02:52,400
background uh this is based on uh some a

68

00:02:55,670 --> 00:02:53,760
lot of brainstorming that has happened

69

00:02:58,229 --> 00:02:55,680
within the last few months

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00:03:00,790 --> 00:02:58,239
and a lot of that occurred

71

00:03:03,030 --> 00:03:00,800
at a at a meeting in wallops flight

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00:03:04,390 --> 00:03:03,040
space flight center

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00:03:07,910 --> 00:03:04,400
our flight facility

74

00:03:09,750 --> 00:03:07,920
in um in june and this is this is a list

75

00:03:11,990 --> 00:03:09,760
of some of the people who are involved

76

00:03:14,790 --> 00:03:12,000

on site and virtually and that many of

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00:03:16,869 --> 00:03:14,800

whom have contributed since um i i'm

78

00:03:19,110 --> 00:03:16,879

sure some of you are looking at the uh

79

00:03:21,670 --> 00:03:19,120

the document that has emerged uh as a

80

00:03:23,270 --> 00:03:21,680

result right now

81

00:03:25,030 --> 00:03:23,280

and if you look at you can look at older

82

00:03:27,430 --> 00:03:25,040

versions of the document by looking at a

83

00:03:29,910 --> 00:03:27,440

revision history and you can see some of

84

00:03:31,750 --> 00:03:29,920

the original material that fed into this

85

00:03:33,990 --> 00:03:31,760

condensation that uh

86

00:03:36,550 --> 00:03:34,000

that we dave and i have largely put

87

00:03:37,589 --> 00:03:36,560

together in the last few weeks

88

00:03:39,350 --> 00:03:37,599

um

89

00:03:42,309 --> 00:03:39,360

so

90

00:03:43,750 --> 00:03:42,319

this particular document comes about

91

00:03:45,830 --> 00:03:43,760

at a request

92

00:03:47,509 --> 00:03:45,840

to reorganize things along along the

93

00:03:48,789 --> 00:03:47,519

same shown here so these are the

94

00:03:50,630 --> 00:03:48,799

documents that you'll see online that

95

00:03:52,070 --> 00:03:50,640

we're covering in the last week

96

00:03:53,270 --> 00:03:52,080

and uh this week

97

00:03:57,509 --> 00:03:53,280

um

98

00:03:59,030 --> 00:03:57,519

environments in our solar system hits

99

00:04:02,070 --> 00:03:59,040

with broader questions

100

00:04:04,710 --> 00:04:02,080

of um how do habitable systems form uh

101
00:04:06,630 --> 00:04:04,720
how can a world generate life and how do

102
00:04:09,830 --> 00:04:06,640
we search for life in the solar system

103
00:04:12,390 --> 00:04:09,840
uh once we understand a habitability um

104
00:04:13,990 --> 00:04:12,400
and where it occurs uh and beyond that

105
00:04:16,710 --> 00:04:14,000
how do we extend those questions to

106
00:04:19,830 --> 00:04:16,720
habitable planets uh and the search for

107
00:04:21,349 --> 00:04:19,840
life beyond our solar system

108
00:04:23,189 --> 00:04:21,359
all right so those original documents

109
00:04:25,189 --> 00:04:23,199
that i mentioned that came about uh

110
00:04:26,629 --> 00:04:25,199
during that wallops meeting

111
00:04:29,270 --> 00:04:26,639
um are

112
00:04:30,710 --> 00:04:29,280
titled as as you see here

113
00:04:32,790 --> 00:04:30,720

covering the search for life in other

114

00:04:35,030 --> 00:04:32,800

worlds in the solar system how how we

115

00:04:36,230 --> 00:04:35,040

would remotely find and identify

116

00:04:39,350 --> 00:04:36,240

inhabitants

117

00:04:42,550 --> 00:04:39,360

uh where on on mars uh life could have

118

00:04:45,189 --> 00:04:42,560

emerged uh where it could exist today um

119

00:04:47,430 --> 00:04:45,199

questions as specific as a focus on

120

00:04:49,830 --> 00:04:47,440

perchlorate as an electron acceptor for

121

00:04:51,909 --> 00:04:49,840

organisms so um you can see there's an

122

00:04:53,350 --> 00:04:51,919

emphasis that emerged

123

00:04:55,990 --> 00:04:53,360

based on the interest of the people who

124

00:04:57,430 --> 00:04:56,000

contributed to the document um you know

125

00:04:59,430 --> 00:04:57,440

there was a group of people who were

126

00:05:01,189 --> 00:04:59,440

interested specifically in titan as the

127

00:05:02,469 --> 00:05:01,199

national biological target

128

00:05:04,070 --> 00:05:02,479

um

129

00:05:05,830 --> 00:05:04,080

and there were there's another group

130

00:05:08,150 --> 00:05:05,840

that was interested in trying to ask the

131

00:05:09,990 --> 00:05:08,160

broad question of how can a world

132

00:05:11,510 --> 00:05:10,000

generate life

133

00:05:15,110 --> 00:05:11,520

and how we can characterize and

134

00:05:17,909 --> 00:05:15,120

understand um those worlds so so there's

135

00:05:21,110 --> 00:05:17,919

there's both a specific aspect and an

136

00:05:23,670 --> 00:05:21,120

effort to generalize to processes and so

137

00:05:25,270 --> 00:05:23,680

we'll try to be faithful uh to the

138

00:05:27,830 --> 00:05:25,280

specific questions that came about in

139

00:05:29,749 --> 00:05:27,840

those individual documents while

140

00:05:30,950 --> 00:05:29,759

also trying to group things into

141

00:05:32,070 --> 00:05:30,960

processes

142

00:05:34,870 --> 00:05:32,080

okay so

143

00:05:37,749 --> 00:05:34,880

looking at the the thinking that emerged

144

00:05:40,390 --> 00:05:37,759

from this exercise uh we were led to

145

00:05:43,590 --> 00:05:40,400

identify some starting questions basic

146

00:05:46,310 --> 00:05:43,600

questions of um

147

00:05:48,230 --> 00:05:46,320

how planetary exploration can inform our

148

00:05:49,830 --> 00:05:48,240

understanding of where life could occur

149

00:05:51,670 --> 00:05:49,840

uh basically we need to understand

150

00:05:53,590 --> 00:05:51,680

habitability first

151
00:05:55,670 --> 00:05:53,600
and we need to ask questions about

152
00:05:58,070 --> 00:05:55,680
specifically in the next decade but as

153
00:06:00,070 --> 00:05:58,080
science progresses in general

154
00:06:01,510 --> 00:06:00,080
what measurements and models are needed

155
00:06:03,590 --> 00:06:01,520
to constrain our definition of

156
00:06:06,550 --> 00:06:03,600
habitability

157
00:06:08,070 --> 00:06:06,560
and as we as we explore the solar system

158
00:06:11,510 --> 00:06:08,080
by all the means that are available at

159
00:06:13,510 --> 00:06:11,520
our uh disposal um how can we understand

160
00:06:16,309 --> 00:06:13,520
habitability in that context both past

161
00:06:18,629 --> 00:06:16,319
and present uh in the context of planets

162
00:06:21,029 --> 00:06:18,639
and objects that we're observing my

163
00:06:22,629 --> 00:06:21,039

definition of planet is pretty loose uh

164

00:06:23,909 --> 00:06:22,639

i'd be interested in discussing what

165

00:06:26,070 --> 00:06:23,919

people think of when they think of the

166

00:06:27,350 --> 00:06:26,080

objects that should be included in this

167

00:06:28,870 --> 00:06:27,360

discussion

168

00:06:31,749 --> 00:06:28,880

but generally

169

00:06:33,029 --> 00:06:31,759

the the idea is to be very open and to

170

00:06:34,230 --> 00:06:33,039

think about all the different questions

171

00:06:36,150 --> 00:06:34,240

that we should really be asking

172

00:06:37,590 --> 00:06:36,160

specifically in american decade when it

173

00:06:40,150 --> 00:06:37,600

comes to looking for habitability in the

174

00:06:42,070 --> 00:06:40,160

solar system

175

00:06:44,070 --> 00:06:42,080

okay so

176

00:06:46,710 --> 00:06:44,080

the the documents that were the source

177

00:06:48,309 --> 00:06:46,720

for this material inevitably

178

00:06:50,309 --> 00:06:48,319

touched on different modes of

179

00:06:52,070 --> 00:06:50,319

exploration and so we thought it would

180

00:06:54,790 --> 00:06:52,080

be useful to

181

00:06:58,150 --> 00:06:54,800

organize things loosely in those terms

182

00:06:59,909 --> 00:06:58,160

uh specifically uh what what we can

183

00:07:01,189 --> 00:06:59,919

learn from remote sensing that's both

184

00:07:03,189 --> 00:07:01,199

ground-based

185

00:07:04,790 --> 00:07:03,199

and orbital

186

00:07:06,309 --> 00:07:04,800

by looking at the broad characteristics

187

00:07:09,589 --> 00:07:06,319

of objects of interest

188

00:07:10,950 --> 00:07:09,599

mapping environmental indicators um

189

00:07:13,830 --> 00:07:10,960

and this

190

00:07:15,670 --> 00:07:13,840

can be viewed as having a feed forward

191

00:07:18,710 --> 00:07:15,680

to the the other mode of exploration

192

00:07:21,589 --> 00:07:18,720

that follows that uh in this list which

193

00:07:24,390 --> 00:07:21,599

is in situ exploration um getting down

194

00:07:27,510 --> 00:07:24,400

to detail uh and asking some similar

195

00:07:28,830 --> 00:07:27,520

questions um but inevitably with it with

196

00:07:32,390 --> 00:07:28,840

a different

197

00:07:34,469 --> 00:07:32,400

um set of set of tools at our disposal

198

00:07:36,629 --> 00:07:34,479

that allows us to to address those

199

00:07:38,950 --> 00:07:36,639

questions in unique ways

200

00:07:41,350 --> 00:07:38,960

similarly

201
00:07:42,550 --> 00:07:41,360
there are examples of sample return

202
00:07:43,510 --> 00:07:42,560
within the solar system that have

203
00:07:44,790 --> 00:07:43,520
yielded

204
00:07:46,550 --> 00:07:44,800
important

205
00:07:48,950 --> 00:07:46,560
answers to questions about about the

206
00:07:51,510 --> 00:07:48,960
origin of the solar system and sample

207
00:07:54,309 --> 00:07:51,520
return figures heavily in considerations

208
00:07:55,589 --> 00:07:54,319
of where astrobiology is headed

209
00:07:56,790 --> 00:07:55,599
so that's something that we want to

210
00:07:59,110 --> 00:07:56,800
include in the discussion and that

211
00:08:00,869 --> 00:07:59,120
certainly figured into the documents

212
00:08:05,110 --> 00:08:00,879
that that were the source for this

213
00:08:07,749 --> 00:08:05,909

so

214

00:08:08,790 --> 00:08:07,759

the first of those themes uh remote

215

00:08:12,390 --> 00:08:08,800

sensing

216

00:08:13,990 --> 00:08:12,400

uh habitability and indicators uh we if

217

00:08:14,950 --> 00:08:14,000

you look at the document i imagine a lot

218

00:08:16,710 --> 00:08:14,960

of you are looking at the document

219

00:08:18,790 --> 00:08:16,720

online right now

220

00:08:20,629 --> 00:08:18,800

a lot of the questions from those source

221

00:08:22,869 --> 00:08:20,639

documents ended up in this remote

222

00:08:24,950 --> 00:08:22,879

sensing section now that's not to say

223

00:08:28,710 --> 00:08:24,960

that a lot of those questions don't also

224

00:08:31,270 --> 00:08:28,720

apply to in-situ or sample return and

225

00:08:32,949 --> 00:08:31,280

really the document might be reorganized

226

00:08:35,029 --> 00:08:32,959

so the introduction and

227

00:08:36,310 --> 00:08:35,039

touches on some of those questions

228

00:08:38,630 --> 00:08:36,320

in any case

229

00:08:40,070 --> 00:08:38,640

some of the themes that come up in the

230

00:08:42,550 --> 00:08:40,080

context of searching for habitability in

231

00:08:44,949 --> 00:08:42,560

the solar system which are

232

00:08:46,949 --> 00:08:44,959

broadly addressed by remote sensing are

233

00:08:49,350 --> 00:08:46,959

determining global and regional scales

234

00:08:51,030 --> 00:08:49,360

of processes um

235

00:08:52,430 --> 00:08:51,040

i think what are the inventories of

236

00:08:54,550 --> 00:08:52,440

resources that are related to

237

00:08:55,430 --> 00:08:54,560

habitability uh

238

00:08:58,070 --> 00:08:55,440

and

239

00:09:01,030 --> 00:08:58,080

again that that relates to a future more

240

00:09:02,790 --> 00:09:01,040

specific uh investigation uh as an

241

00:09:04,470 --> 00:09:02,800

example um

242

00:09:06,870 --> 00:09:04,480

you know we want to do

243

00:09:08,389 --> 00:09:06,880

or one would be interested in getting

244

00:09:09,590 --> 00:09:08,399

high high-resolution maps of our surface

245

00:09:12,949 --> 00:09:09,600

in order to understand where to look for

246

00:09:14,230 --> 00:09:12,959

habitability and my view is that

247

00:09:16,550 --> 00:09:14,240

in in

248

00:09:18,550 --> 00:09:16,560

future exploration one needs to get down

249

00:09:20,870 --> 00:09:18,560

below the meter scale to understand

250

00:09:22,550 --> 00:09:20,880

where process related to habitability uh

251
00:09:24,070 --> 00:09:22,560
occur

252
00:09:25,590 --> 00:09:24,080
okay so

253
00:09:26,630 --> 00:09:25,600
specifically when looking at what those

254
00:09:29,030 --> 00:09:26,640
environments

255
00:09:31,350 --> 00:09:29,040
are we want to look for

256
00:09:32,870 --> 00:09:31,360
the materials that are related to life

257
00:09:35,030 --> 00:09:32,880
and our understanding of life is that

258
00:09:37,269 --> 00:09:35,040
solvents are required for fostering

259
00:09:40,550 --> 00:09:37,279
chemical disequilibria uh specifically

260
00:09:42,949 --> 00:09:40,560
water has a strong role as we're all i'm

261
00:09:44,310 --> 00:09:42,959
sure quite

262
00:09:46,630 --> 00:09:44,320
familiar

263
00:09:49,190 --> 00:09:46,640

so we want to look for evidence and for

264

00:09:50,790 --> 00:09:49,200

water understand the duration uh

265

00:09:52,470 --> 00:09:50,800

lifetime of water

266

00:09:56,150 --> 00:09:52,480

and what are the what are the subsurface

267

00:09:59,590 --> 00:09:56,160

reservoirs of water be they on um

268

00:10:01,750 --> 00:09:59,600

enceladus europa mars uh potentially

269

00:10:04,710 --> 00:10:01,760

even water on the moon is is important

270

00:10:05,509 --> 00:10:04,720

in the context of habitability

271

00:10:07,350 --> 00:10:05,519

so

272

00:10:09,030 --> 00:10:07,360

in general we're looking for

273

00:10:12,230 --> 00:10:09,040

the ingredients of life in the solar

274

00:10:13,990 --> 00:10:12,240

system and this is familiar ground

275

00:10:16,310 --> 00:10:14,000

looking for carbon hydrogen oxygen

276

00:10:18,470 --> 00:10:16,320

nitrogen phosphorus sulfur

277

00:10:20,470 --> 00:10:18,480

looking for key chemical signatures okay

278

00:10:23,350 --> 00:10:20,480

so these are these are the broad things

279

00:10:25,590 --> 00:10:23,360

uh sources of energy um both solar

280

00:10:27,670 --> 00:10:25,600

energy and also internal energy uh and

281

00:10:30,710 --> 00:10:27,680

also processes that that might drive

282

00:10:33,269 --> 00:10:30,720

chemical basic equilibria

283

00:10:34,630 --> 00:10:33,279

and then asking what's what's the um

284

00:10:37,110 --> 00:10:34,640

what are the processes that either

285

00:10:39,430 --> 00:10:37,120

destroy or preserve those signatures of

286

00:10:40,470 --> 00:10:39,440

habitability okay so

287

00:10:42,630 --> 00:10:40,480

these are these are some of the things

288

00:10:44,150 --> 00:10:42,640

that have emerged uh from considering

289

00:10:46,230 --> 00:10:44,160

the broad input

290

00:10:48,870 --> 00:10:46,240

but specific questions that were raised

291

00:10:51,030 --> 00:10:48,880

in the the source documents um that are

292

00:10:53,030 --> 00:10:51,040

captured in this remote sensing section

293

00:10:55,430 --> 00:10:53,040

were uh what's the nature of water rock

294

00:10:58,550 --> 00:10:55,440

interactions on on different objects uh

295

00:11:00,470 --> 00:10:58,560

what are sources of water and gases that

296

00:11:03,269 --> 00:11:00,480

are observed in the examples that were

297

00:11:05,590 --> 00:11:03,279

raised were mars and enceladus but

298

00:11:06,949 --> 00:11:05,600

generally where we find emissions what's

299

00:11:08,389 --> 00:11:06,959

what's the what are the sources for

300

00:11:09,990 --> 00:11:08,399

those

301
00:11:13,590 --> 00:11:10,000
and what are what are the processes that

302
00:11:15,590 --> 00:11:13,600
preserve or alter them again

303
00:11:17,829 --> 00:11:15,600
and uh touching on chemical energy

304
00:11:20,150 --> 00:11:17,839
sources there were there were specific

305
00:11:22,790 --> 00:11:20,160
questions about oxidants on mars like

306
00:11:24,949 --> 00:11:22,800
perchlorate uh in the context of titan

307
00:11:27,590 --> 00:11:24,959
what is the source of oxygen uh for

308
00:11:29,190 --> 00:11:27,600
putative life forms um

309
00:11:30,790 --> 00:11:29,200
what are the sources for reductance in

310
00:11:32,710 --> 00:11:30,800
general on different objects that might

311
00:11:34,069 --> 00:11:32,720
be habitable uh what are the internal

312
00:11:35,350 --> 00:11:34,079
sources of energy

313
00:11:36,710 --> 00:11:35,360

um

314

00:11:38,870 --> 00:11:36,720

what else

315

00:11:41,670 --> 00:11:38,880

and uh again what's the distribution of

316

00:11:42,470 --> 00:11:41,680

habitable environments okay so for these

317

00:11:44,949 --> 00:11:42,480

these

318

00:11:48,150 --> 00:11:44,959

uh modes of exploration we identified we

319

00:11:51,350 --> 00:11:48,160

wanted to provide examples of past

320

00:11:54,470 --> 00:11:51,360

and uh future missions that are that are

321

00:11:56,470 --> 00:11:54,480

slated to be launched um that that

322

00:11:59,509 --> 00:11:56,480

contribute to addressing these questions

323

00:12:01,509 --> 00:11:59,519

and we wanted to cast that very broadly

324

00:12:03,509 --> 00:12:01,519

so in the category of remote sensing i

325

00:12:05,750 --> 00:12:03,519

include the telescopes as an example of

326

00:12:07,509 --> 00:12:05,760

ground-based observatories that can be

327

00:12:10,150 --> 00:12:07,519

used have been used to address questions

328

00:12:12,870 --> 00:12:10,160

related to habitability uh there's a

329

00:12:15,190 --> 00:12:12,880

host of other missions mars missions uh

330

00:12:18,230 --> 00:12:15,200

the voyager galileo cassini missions and

331

00:12:20,550 --> 00:12:18,240

missions um in the future um

332

00:12:21,910 --> 00:12:20,560

that are listed here

333

00:12:23,350 --> 00:12:21,920

this list is not meant to be

334

00:12:26,310 --> 00:12:23,360

comprehensive and i hope that in our

335

00:12:27,430 --> 00:12:26,320

discussion we can touch on other

336

00:12:29,750 --> 00:12:27,440

aspects

337

00:12:30,550 --> 00:12:29,760

also perhaps on uh missions that have

338

00:12:33,910 --> 00:12:30,560

been

339

00:12:39,590 --> 00:12:33,920

studied as possible future aspects

340

00:12:44,629 --> 00:12:42,069

oh okay i guess i'll take over this part

341

00:12:47,990 --> 00:12:44,639

of the uh of the presentation now we're

342

00:12:49,829 --> 00:12:48,000

switching now to in situ exploration um

343

00:12:51,670 --> 00:12:49,839

so the key role then again of the

344

00:12:53,829 --> 00:12:51,680

orbital observations in addition to

345

00:12:55,269 --> 00:12:53,839

documenting sort of global scale process

346

00:12:57,190 --> 00:12:55,279

is to

347

00:12:58,550 --> 00:12:57,200

contribute to the solomonic decision of

348

00:12:59,670 --> 00:12:58,560

where do you send a lander to the

349

00:13:01,350 --> 00:12:59,680

surface

350

00:13:02,790 --> 00:13:01,360

so whereas a lander

351

00:13:04,389 --> 00:13:02,800

has a

352

00:13:05,910 --> 00:13:04,399

a lot of things it can do by being right

353

00:13:08,710 --> 00:13:05,920

up against the surface in terms of

354

00:13:11,910 --> 00:13:08,720

observations in detail uh it is very

355

00:13:13,670 --> 00:13:11,920

hostage uh to your global perspective

356

00:13:16,230 --> 00:13:13,680

and your best guesses to the most

357

00:13:18,949 --> 00:13:16,240

promising places on the surface of any

358

00:13:20,790 --> 00:13:18,959

object and so you can see how these two

359

00:13:22,790 --> 00:13:20,800

modes of exploration really have to be

360

00:13:25,269 --> 00:13:22,800

done in concert with each other but once

361

00:13:26,629 --> 00:13:25,279

you're down at the surface uh that what

362

00:13:29,430 --> 00:13:26,639

you're seeing here

363

00:13:32,310 --> 00:13:29,440

is a whole checklist of features that

364

00:13:33,110 --> 00:13:32,320

they that a land or rover

365

00:13:36,150 --> 00:13:33,120

could

366

00:13:37,670 --> 00:13:36,160

to really characterize the current

367

00:13:38,949 --> 00:13:37,680

environment as well as the past

368

00:13:41,590 --> 00:13:38,959

environment and

369

00:13:43,910 --> 00:13:41,600

you know and so part of this is to put

370

00:13:45,190 --> 00:13:43,920

out to the astrobiology community

371

00:13:47,190 --> 00:13:45,200

uh the

372

00:13:49,509 --> 00:13:47,200

types of measurements in a very generic

373

00:13:51,430 --> 00:13:49,519

sense that represent opportunities for

374

00:13:53,509 --> 00:13:51,440

this community to utilize

375

00:13:55,990 --> 00:13:53,519

to to do the kind of characterization

376

00:13:58,629 --> 00:13:56,000

that they feel is important uh to

377

00:14:00,870 --> 00:13:58,639

address this issue of habitability uh

378

00:14:03,590 --> 00:14:00,880

not only whether it existed but how long

379

00:14:05,750 --> 00:14:03,600

it it persisted as some kind of a

380

00:14:07,430 --> 00:14:05,760

measure of

381

00:14:08,949 --> 00:14:07,440

you know the past environment and the

382

00:14:11,030 --> 00:14:08,959

prospect that it might have harbored

383

00:14:12,470 --> 00:14:11,040

life at some time so i think without

384

00:14:13,590 --> 00:14:12,480

going down this list i think when you

385

00:14:16,230 --> 00:14:13,600

look at it you can it's pretty

386

00:14:18,470 --> 00:14:16,240

self-explanatory it really addresses

387

00:14:19,430 --> 00:14:18,480

morphologic features mineralogic

388

00:14:22,310 --> 00:14:19,440

features

389

00:14:24,949 --> 00:14:22,320

chemist chemistry isotopes all the usual

390

00:14:26,790 --> 00:14:24,959

suspects uh that are not only

391

00:14:28,949 --> 00:14:26,800

examples of of categories of

392

00:14:30,790 --> 00:14:28,959

biosignatures they are examples of

393

00:14:34,389 --> 00:14:30,800

categories of environmental indicators

394

00:14:37,030 --> 00:14:34,399

that could inform the decision to to

395

00:14:39,430 --> 00:14:37,040

about habitability and at the bottom not

396

00:14:41,670 --> 00:14:39,440

last but not least is the whole

397

00:14:43,910 --> 00:14:41,680

topic of subsurface

398

00:14:45,590 --> 00:14:43,920

environments and therefore

399

00:14:47,670 --> 00:14:45,600

astrobiologists need to think about

400

00:14:50,069 --> 00:14:47,680

geophysical and geochemical indicators

401
00:14:51,829 --> 00:14:50,079
of the subsurface as it appears for many

402
00:14:53,829 --> 00:14:51,839
of the objects in particular the icy

403
00:14:56,550 --> 00:14:53,839
moons of the outer solar system the

404
00:14:58,629 --> 00:14:56,560
subservice is a very promising venue for

405
00:15:00,629 --> 00:14:58,639
certainly present habitability as well

406
00:15:02,870 --> 00:15:00,639
as past so

407
00:15:04,470 --> 00:15:02,880
these are the kinds of

408
00:15:06,150 --> 00:15:04,480
of measurements that uh that the

409
00:15:07,750 --> 00:15:06,160
community should be making inputs about

410
00:15:09,829 --> 00:15:07,760
as to how

411
00:15:11,670 --> 00:15:09,839
missions should be capable as they go

412
00:15:13,430 --> 00:15:11,680
forward and of course

413
00:15:14,790 --> 00:15:13,440

with greatest relevance perhaps to

414

00:15:17,030 --> 00:15:14,800

future missions where there's still a

415

00:15:18,389 --> 00:15:17,040

lot of input to the nature of what those

416

00:15:21,110 --> 00:15:18,399

missions might be

417

00:15:24,310 --> 00:15:21,120

uh the next slide which i have to use

418

00:15:26,470 --> 00:15:24,320

doing this i got it thank you uh again

419

00:15:29,030 --> 00:15:26,480

example key questions and again as steve

420

00:15:32,150 --> 00:15:29,040

mentioned we tried to pull these from

421

00:15:33,670 --> 00:15:32,160

the source text document that that have

422

00:15:36,230 --> 00:15:33,680

been developed over the last several

423

00:15:38,790 --> 00:15:36,240

months and so obviously some of these

424

00:15:40,790 --> 00:15:38,800

are recognizable again and similar to

425

00:15:41,670 --> 00:15:40,800

what we saw in the remote sensing

426
00:15:43,430 --> 00:15:41,680
section

427
00:15:46,230 --> 00:15:43,440
and that is of course what are the major

428
00:15:49,590 --> 00:15:46,240
lithologies at the surface as indicators

429
00:15:51,910 --> 00:15:49,600
of of the types of ingredients and and

430
00:15:54,790 --> 00:15:51,920
and features that are needed to support

431
00:15:56,790 --> 00:15:54,800
habitability and obviously titan europa

432
00:15:58,230 --> 00:15:56,800
and mars are going to be quite different

433
00:16:00,150 --> 00:15:58,240
objects with respect to those

434
00:16:02,150 --> 00:16:00,160
lithologies and they're those those

435
00:16:04,629 --> 00:16:02,160
crustal compositions really provide a

436
00:16:06,230 --> 00:16:04,639
context for any habitable conditions

437
00:16:08,790 --> 00:16:06,240
that we would be able to get direct

438
00:16:11,430 --> 00:16:08,800

access to and of course to the extent

439

00:16:13,670 --> 00:16:11,440

that surface materials given clue as to

440

00:16:15,430 --> 00:16:13,680

what's in the subsurface perhaps because

441

00:16:16,389 --> 00:16:15,440

of some kind of an eruptive event or

442

00:16:18,790 --> 00:16:16,399

something

443

00:16:21,430 --> 00:16:18,800

they also give us

444

00:16:23,350 --> 00:16:21,440

to proceed with subsurface exploration

445

00:16:25,350 --> 00:16:23,360

uh water rock interaction steve already

446

00:16:27,990 --> 00:16:25,360

mentioned sources and sinks of things

447

00:16:30,389 --> 00:16:28,000

obviously inventories all the usual

448

00:16:31,910 --> 00:16:30,399

stuff organic matter now of course that

449

00:16:33,670 --> 00:16:31,920

you're at the surface

450

00:16:35,509 --> 00:16:33,680

you have the ability to do much more

451
00:16:37,189 --> 00:16:35,519
about detection of organic matter and

452
00:16:39,189 --> 00:16:37,199
characterization of it

453
00:16:41,030 --> 00:16:39,199
and we're not just talking about organic

454
00:16:43,350 --> 00:16:41,040
matter as an indicator of life

455
00:16:46,310 --> 00:16:43,360
necessarily in the case of an object

456
00:16:48,629 --> 00:16:46,320
like titan or maybe europa uh organic

457
00:16:51,829 --> 00:16:48,639
matter could tell you a lot about the uh

458
00:16:54,230 --> 00:16:51,839
the the processes sort of large-scale

459
00:16:56,310 --> 00:16:54,240
processes that uh are related to

460
00:16:58,069 --> 00:16:56,320
determining habitable environments and

461
00:17:00,150 --> 00:16:58,079
of course obviously organic matter in

462
00:17:01,910 --> 00:17:00,160
itself is a source of a key ingredient

463
00:17:02,949 --> 00:17:01,920

potentially to any life form that might

464

00:17:04,549 --> 00:17:02,959

be there

465

00:17:06,789 --> 00:17:04,559

and so

466

00:17:08,150 --> 00:17:06,799

likewise oxidants reductants to address

467

00:17:10,870 --> 00:17:08,160

the energy

468

00:17:13,270 --> 00:17:10,880

aspect and then just general conditions

469

00:17:15,590 --> 00:17:13,280

um you know how saline are fresh is the

470

00:17:17,669 --> 00:17:15,600

water uh and how does that comply with

471

00:17:19,429 --> 00:17:17,679

our concept you know how does that

472

00:17:21,990 --> 00:17:19,439

interact with our concepts of what is

473

00:17:24,230 --> 00:17:22,000

required for habitability uh temperature

474

00:17:27,110 --> 00:17:24,240

ph radiation all these things contribute

475

00:17:28,549 --> 00:17:27,120

to an assessment of habitability um and

476

00:17:31,590 --> 00:17:28,559

i keep i just want to make a few more

477

00:17:32,549 --> 00:17:31,600

comments about this idea of preservation

478

00:17:34,070 --> 00:17:32,559

um

479

00:17:35,669 --> 00:17:34,080

you know it's not just enough to think

480

00:17:36,950 --> 00:17:35,679

that you've you've landed at a place

481

00:17:39,830 --> 00:17:36,960

where that might have been habitable in

482

00:17:41,750 --> 00:17:39,840

the past what you also really need is to

483

00:17:43,990 --> 00:17:41,760

have materials that you can then access

484

00:17:46,310 --> 00:17:44,000

with your spacecraft that really will

485

00:17:47,990 --> 00:17:46,320

inform you about more details about what

486

00:17:49,190 --> 00:17:48,000

past environments or even present

487

00:17:50,789 --> 00:17:49,200

environments might be and so

488

00:17:52,870 --> 00:17:50,799

preservation is really an important

489

00:17:55,110 --> 00:17:52,880

thing here it's not just doesn't just

490

00:17:57,190 --> 00:17:55,120

apply to biosignatures it applies to any

491

00:17:59,430 --> 00:17:57,200

indicator of an environment that is

492

00:18:02,150 --> 00:17:59,440

remote from you or either because of

493

00:18:04,470 --> 00:18:02,160

time or because it's in the subsurface

494

00:18:06,310 --> 00:18:04,480

we need to think about these landing

495

00:18:08,549 --> 00:18:06,320

sites and think about measurements that

496

00:18:10,789 --> 00:18:08,559

really help us to assess

497

00:18:12,950 --> 00:18:10,799

you know the materials that we are able

498

00:18:14,390 --> 00:18:12,960

to observe with respect to how well they

499

00:18:16,630 --> 00:18:14,400

have preserved the information that

500

00:18:19,110 --> 00:18:16,640

we're after and so this applies not only

501
00:18:21,669 --> 00:18:19,120
to biosignatures but to indicators of

502
00:18:24,070 --> 00:18:21,679
past conditions with particular emphasis

503
00:18:26,310 --> 00:18:24,080
on habitability and so i think this

504
00:18:29,029 --> 00:18:26,320
concept of taphonomy this is a word not

505
00:18:31,830 --> 00:18:29,039
familiar to some of you is is just the

506
00:18:33,830 --> 00:18:31,840
relationship between an uh it's from to

507
00:18:35,909 --> 00:18:33,840
actually in it's a biological term the

508
00:18:37,830 --> 00:18:35,919
relationship between the living organism

509
00:18:39,909 --> 00:18:37,840
and its fossil equivalent preserved in

510
00:18:41,270 --> 00:18:39,919
the rock record what are the changes

511
00:18:42,870 --> 00:18:41,280
that happen how can you look at the

512
00:18:45,350 --> 00:18:42,880
fossil and relate that back to the

513
00:18:47,270 --> 00:18:45,360

original organism that whole area of

514

00:18:49,510 --> 00:18:47,280

study is called taphonomy and so in a

515

00:18:52,150 --> 00:18:49,520

way maybe we should be talking about a

516

00:18:54,070 --> 00:18:52,160

taphonomy of environmental indicators how

517

00:18:55,990 --> 00:18:54,080

does this indicator that's preserved in

518

00:18:57,430 --> 00:18:56,000

front of you as your in your spacecraft

519

00:18:58,950 --> 00:18:57,440

as you're looking at it how does that

520

00:19:00,870 --> 00:18:58,960

relate to the original environment that

521

00:19:02,630 --> 00:19:00,880

you're trying to understand so this is

522

00:19:05,510 --> 00:19:02,640

an important part of

523

00:19:07,669 --> 00:19:05,520

of planetary exploration that we're

524

00:19:09,669 --> 00:19:07,679

really now beginning to realize i think

525

00:19:11,430 --> 00:19:09,679

particularly in mars exploration but

526

00:19:13,110 --> 00:19:11,440

given the radiation environments of the

527

00:19:14,150 --> 00:19:13,120

outer solar system i think it's also

528

00:19:16,390 --> 00:19:14,160

relevant

529

00:19:18,549 --> 00:19:16,400

okay so

530

00:19:20,150 --> 00:19:18,559

with this measurements and capabilities

531

00:19:21,270 --> 00:19:20,160

again i don't want to dwell on this too

532

00:19:23,669 --> 00:19:21,280

much

533

00:19:26,150 --> 00:19:23,679

a lot of this of course is heritage from

534

00:19:28,630 --> 00:19:26,160

the rovers that we have sent to mars but

535

00:19:30,630 --> 00:19:28,640

any any of any spacecraft you send to

536

00:19:33,270 --> 00:19:30,640

the surface of any object in the outer

537

00:19:35,270 --> 00:19:33,280

solar system or whatever uh

538

00:19:38,390 --> 00:19:35,280

probably will be involved these sort of

539

00:19:40,390 --> 00:19:38,400

generic measurement capabilities and so

540

00:19:41,909 --> 00:19:40,400

in the context of these various objects

541

00:19:42,950 --> 00:19:41,919

the astrobiology community needs to

542

00:19:44,070 --> 00:19:42,960

think about

543

00:19:46,710 --> 00:19:44,080

you know

544

00:19:48,070 --> 00:19:46,720

what what what progress is needed in in

545

00:19:50,150 --> 00:19:48,080

the development of measurements

546

00:19:51,990 --> 00:19:50,160

techniques instruments for spacecraft

547

00:19:54,630 --> 00:19:52,000

that will not only make the measurement

548

00:19:56,549 --> 00:19:54,640

but that can be accommodated within the

549

00:19:58,310 --> 00:19:56,559

resource constraints of that mission and

550

00:20:00,789 --> 00:19:58,320

it's not just the size of it and the

551
00:20:02,710 --> 00:20:00,799
power capabilities of the spacecraft but

552
00:20:05,510 --> 00:20:02,720
as you can imagine these days it's the

553
00:20:07,590 --> 00:20:05,520
budgetary constraints how can we

554
00:20:09,190 --> 00:20:07,600
address this list effectively given all

555
00:20:11,110 --> 00:20:09,200
these constraints on space flight

556
00:20:13,750 --> 00:20:11,120
instruments and and achieve the

557
00:20:15,750 --> 00:20:13,760
astrobiology objectives that we need and

558
00:20:18,230 --> 00:20:15,760
not to ignore of course at the bottom of

559
00:20:20,789 --> 00:20:18,240
this list the issues of mobility and

560
00:20:22,870 --> 00:20:20,799
sample acquisition these are expensive

561
00:20:24,549 --> 00:20:22,880
items and the question again to the

562
00:20:26,390 --> 00:20:24,559
community if you wanted to explore the

563
00:20:28,470 --> 00:20:26,400

surface of titan or europa or whatever

564

00:20:30,549 --> 00:20:28,480

how do you put together how do you

565

00:20:32,149 --> 00:20:30,559

contribute to a science definition team

566

00:20:34,230 --> 00:20:32,159

that was trying to come up with a design

567

00:20:36,149 --> 00:20:34,240

for a spacecraft and so the community

568

00:20:37,110 --> 00:20:36,159

needs to make inputs along these lines

569

00:20:38,789 --> 00:20:37,120

as well

570

00:20:40,630 --> 00:20:38,799

in terms of the in the context of the

571

00:20:42,070 --> 00:20:40,640

science that needs to needs to be

572

00:20:43,990 --> 00:20:42,080

achieved

573

00:20:47,830 --> 00:20:44,000

and so i think

574

00:20:49,990 --> 00:20:47,840

we go to the next slide the themes

575

00:20:51,990 --> 00:20:50,000

okay now so that's pretty much it for

576

00:20:53,830 --> 00:20:52,000

inside you and i think as some people

577

00:20:56,549 --> 00:20:53,840

have already commented there needs to be

578

00:20:58,710 --> 00:20:56,559

more questions science questions and and

579

00:21:00,470 --> 00:20:58,720

specific science investigations as

580

00:21:04,390 --> 00:21:00,480

examples of the kinds of things we would

581

00:21:06,149 --> 00:21:04,400

like to do in land admissions and so

582

00:21:07,750 --> 00:21:06,159

i think steve and i were pretty faithful

583

00:21:10,390 --> 00:21:07,760

to trying to pull things out of the

584

00:21:13,430 --> 00:21:10,400

source documents for this uh to populate

585

00:21:15,750 --> 00:21:13,440

this template but we obviously want more

586

00:21:17,669 --> 00:21:15,760

input from folks now that they see sort

587

00:21:19,990 --> 00:21:17,679

of this landscape of things that need to

588

00:21:22,390 --> 00:21:20,000

be addressed uh what could be some more

589

00:21:24,710 --> 00:21:22,400

example questions of astrobiology

590

00:21:26,470 --> 00:21:24,720

investigations that would be done at the

591

00:21:28,149 --> 00:21:26,480

surface if you somehow see what's

592

00:21:30,070 --> 00:21:28,159

already here is not adequate we that

593

00:21:32,390 --> 00:21:30,080

would be great to have more input okay

594

00:21:35,430 --> 00:21:32,400

the last major theme now did you want to

595

00:21:38,549 --> 00:21:35,440

address this steve or or me

596

00:21:42,070 --> 00:21:40,710

oops you're in you're on mute if you

597

00:21:43,669 --> 00:21:42,080

seem to be muted

598

00:21:46,149 --> 00:21:43,679

okay sorry uh

599

00:21:49,110 --> 00:21:46,159

my gesturing was sufficient to say uh

600

00:21:50,630 --> 00:21:49,120

i'm okay either way but um yeah dave i

601
00:21:52,149 --> 00:21:50,640
thought you might have uh some

602
00:21:53,669 --> 00:21:52,159
particular perspectives on this so

603
00:21:54,789 --> 00:21:53,679
please feel free

604
00:21:56,950 --> 00:21:54,799
okay

605
00:21:58,230 --> 00:21:56,960
well um

606
00:22:00,310 --> 00:21:58,240
you know certainly from mars has been

607
00:22:02,310 --> 00:22:00,320
this progression from remote sensing to

608
00:22:04,950 --> 00:22:02,320
land admissions and then the planning to

609
00:22:07,029 --> 00:22:04,960
try to ultimately bring samples back

610
00:22:08,390 --> 00:22:07,039
and i guess the key point is that

611
00:22:10,390 --> 00:22:08,400
perhaps some of the questions that

612
00:22:12,390 --> 00:22:10,400
astrobiologists want to ask

613
00:22:15,110 --> 00:22:12,400

just really require state-of-the-art

614

00:22:16,310 --> 00:22:15,120

laboratories to address them and i think

615

00:22:17,909 --> 00:22:16,320

you know part of the discussions that

616

00:22:19,669 --> 00:22:17,919

i've had with steve and maybe also have

617

00:22:21,830 --> 00:22:19,679

been some of the discussion groups has

618

00:22:23,270 --> 00:22:21,840

been that already for the outer solar

619

00:22:25,750 --> 00:22:23,280

system where you're trying to understand

620

00:22:27,510 --> 00:22:25,760

the origins of volatiles and and just

621

00:22:29,430 --> 00:22:27,520

the materials that comprise some of

622

00:22:31,029 --> 00:22:29,440

these objects that this whole issue of

623

00:22:32,230 --> 00:22:31,039

origins is really important and so

624

00:22:34,310 --> 00:22:32,240

therefore

625

00:22:36,710 --> 00:22:34,320

missions like genesis and stardust and

626

00:22:38,149 --> 00:22:36,720

hayabusa basically

627

00:22:40,630 --> 00:22:38,159

bringing samples back from very

628

00:22:42,870 --> 00:22:40,640

primitive objects is a very important

629

00:22:45,750 --> 00:22:42,880

perspective on understanding the origins

630

00:22:47,830 --> 00:22:45,760

of these uh bodies and so

631

00:22:49,750 --> 00:22:47,840

for example for even for the outer solar

632

00:22:51,110 --> 00:22:49,760

system sample return is playing a very

633

00:22:53,590 --> 00:22:51,120

important role

634

00:22:56,549 --> 00:22:53,600

clearly from the case of mars that's yet

635

00:22:59,110 --> 00:22:56,559

to be achieved but um some of the

636

00:23:01,430 --> 00:22:59,120

reasons for for doing sample return uh

637

00:23:03,430 --> 00:23:01,440

are outlined here and and the key point

638

00:23:05,430 --> 00:23:03,440

here is that you're you're putting

639

00:23:07,590 --> 00:23:05,440

bringing together suites of samples that

640

00:23:09,190 --> 00:23:07,600

were carefully selected from known

641

00:23:10,950 --> 00:23:09,200

environmental context and this is the

642

00:23:13,350 --> 00:23:10,960

one advantage that a sample returned

643

00:23:15,190 --> 00:23:13,360

from a big object has over a meteorite

644

00:23:17,350 --> 00:23:15,200

that landed in your backyard or in

645

00:23:19,190 --> 00:23:17,360

antarctica for that matter you you can

646

00:23:21,110 --> 00:23:19,200

go to the object and in

647

00:23:23,430 --> 00:23:21,120

known environmental context

648

00:23:25,029 --> 00:23:23,440

choose the samples you want as opposed

649

00:23:27,029 --> 00:23:25,039

posed to the samples that mother nature

650

00:23:29,029 --> 00:23:27,039

delivered to you in the meteorite and

651
00:23:30,549 --> 00:23:29,039
then bring that into state of the art

652
00:23:32,870 --> 00:23:30,559
laboratory so it's in a way an

653
00:23:35,190 --> 00:23:32,880
optimization of two worlds good sample

654
00:23:36,870 --> 00:23:35,200
selection state-of-the-art laboratory so

655
00:23:38,470 --> 00:23:36,880
that's the core principle of sample

656
00:23:40,470 --> 00:23:38,480
return

657
00:23:42,789 --> 00:23:40,480
and then of course as i just said for

658
00:23:44,630 --> 00:23:42,799
primitive objects interpreting origins

659
00:23:46,789 --> 00:23:44,640
and compositions of planetary bodies for

660
00:23:48,549 --> 00:23:46,799
mars characterizing environmental

661
00:23:51,029 --> 00:23:48,559
indicators in greater detail and of

662
00:23:52,630 --> 00:23:51,039
course confirming any bio signatures is

663
00:23:54,710 --> 00:23:52,640

a strong conviction in the mars

664

00:23:56,149 --> 00:23:54,720

community that you really need to get

665

00:23:58,310 --> 00:23:56,159

the state of the art laboratory

666

00:24:00,470 --> 00:23:58,320

capability to really confirm a bio

667

00:24:02,470 --> 00:24:00,480

signature and for that i can only offer

668

00:24:05,110 --> 00:24:02,480

you the debate of the

669

00:24:07,270 --> 00:24:05,120

allen hills meteorite and how even in

670

00:24:09,510 --> 00:24:07,280

state of the art laboratories there were

671

00:24:11,750 --> 00:24:09,520

some very contentious and unresolved

672

00:24:13,990 --> 00:24:11,760

issues for quite a while ability to

673

00:24:15,430 --> 00:24:14,000

respond to unanticipated findings by

674

00:24:17,510 --> 00:24:15,440

employing additional measurements and

675

00:24:19,990 --> 00:24:17,520

developing new methods and that is the

676

00:24:22,630 --> 00:24:20,000

idea of the ability to adapt to a

677

00:24:24,070 --> 00:24:22,640

finding that you did not anticipate

678

00:24:26,230 --> 00:24:24,080

when you

679

00:24:27,909 --> 00:24:26,240

return to that sample and of course all

680

00:24:30,549 --> 00:24:27,919

of this involves planetary protection

681

00:24:32,950 --> 00:24:30,559

considerations so the key thing here to

682

00:24:34,870 --> 00:24:32,960

the astrobiology community is for the

683

00:24:37,110 --> 00:24:34,880

all of you with your laboratories on the

684

00:24:38,710 --> 00:24:37,120

earth uh you know with your capabilities

685

00:24:41,510 --> 00:24:38,720

and so forth

686

00:24:44,950 --> 00:24:41,520

how should no what is your role really

687

00:24:47,669 --> 00:24:44,960

in moving astrobiology forward in in

688

00:24:49,750 --> 00:24:47,679

exploration of the solar system

689

00:24:51,830 --> 00:24:49,760

assuming that you could get samples back

690

00:24:53,269 --> 00:24:51,840

and actually analyze them in your lab

691

00:24:54,950 --> 00:24:53,279

what is it that what are the

692

00:24:56,950 --> 00:24:54,960

capabilities that we need to develop

693

00:24:59,430 --> 00:24:56,960

what are the key questions that really

694

00:25:01,430 --> 00:24:59,440

require sample return and of course

695

00:25:04,230 --> 00:25:01,440

that is a way of putting science in the

696

00:25:07,269 --> 00:25:04,240

driver's seat to push for uh sample

697

00:25:09,029 --> 00:25:07,279

return in in areas and in examples where

698

00:25:11,350 --> 00:25:09,039

the astrobiology community thinks are

699

00:25:13,269 --> 00:25:11,360

most appropriate so that's really the

700

00:25:15,669 --> 00:25:13,279

just here in a way this is very

701
00:25:18,230 --> 00:25:15,679
forward-looking because obviously most

702
00:25:19,750 --> 00:25:18,240
sample returns are in the future and we

703
00:25:21,830 --> 00:25:19,760
need the community to sort of weigh in

704
00:25:23,669 --> 00:25:21,840
on the importance of it so with that and

705
00:25:26,070 --> 00:25:23,679
let me hand that to you steve just for

706
00:25:29,350 --> 00:25:26,080
your wrap-up yeah so i thought it'd be

707
00:25:31,350 --> 00:25:29,360
useful to put in one last slide um

708
00:25:33,830 --> 00:25:31,360
uh just on where this document might go

709
00:25:36,710 --> 00:25:33,840
again this this is meant to be uh open

710
00:25:38,870 --> 00:25:36,720
and i i view the the real value of your

711
00:25:41,990 --> 00:25:38,880
fragment as drawing in as much of

712
00:25:43,190 --> 00:25:42,000
planetary exploration as possible to ask

713
00:25:45,190 --> 00:25:43,200

what are the important questions about

714

00:25:47,510 --> 00:25:45,200

habitability we should be asking in the

715

00:25:49,750 --> 00:25:47,520

coming decade um and that's certainly

716

00:25:51,990 --> 00:25:49,760

not meant to advocate for one uh mode of

717

00:25:53,990 --> 00:25:52,000

explanation exploration over another it

718

00:25:56,070 --> 00:25:54,000

definitely resonates with this dave's

719

00:25:57,990 --> 00:25:56,080

comment about uh what types of

720

00:26:00,630 --> 00:25:58,000

measurements are needed and could be

721

00:26:02,870 --> 00:26:00,640

possible in the coming decade um so you

722

00:26:04,789 --> 00:26:02,880

know i i suggested in the first that one

723

00:26:06,470 --> 00:26:04,799

might include perspectives on trends of

724

00:26:08,710 --> 00:26:06,480

instrument development including

725

00:26:10,789 --> 00:26:08,720

measurements that might be possible uh

726

00:26:12,230 --> 00:26:10,799

in situ or or from space in the future

727

00:26:13,110 --> 00:26:12,240

maybe that aren't that aren't available

728

00:26:15,510 --> 00:26:13,120

now

729

00:26:17,190 --> 00:26:15,520

um the other aspect is is what other

730

00:26:18,390 --> 00:26:17,200

objects should we be should we be

731

00:26:20,870 --> 00:26:18,400

including that aren't discussed here

732

00:26:23,590 --> 00:26:20,880

again uh there's an emphasis on

733

00:26:25,190 --> 00:26:23,600

um you know mars europa enceladus titan

734

00:26:27,830 --> 00:26:25,200

that kind of comes through just on the

735

00:26:29,590 --> 00:26:27,840

basis of what was contributed um

736

00:26:33,590 --> 00:26:29,600

and i threw in a last question that was

737

00:26:34,950 --> 00:26:33,600

just meant to be uh to provoke um a real

738

00:26:36,310 --> 00:26:34,960

breadth of discussion

739

00:26:37,190 --> 00:26:36,320

what's the role of human exploration and

740

00:26:38,630 --> 00:26:37,200

all this

741

00:26:41,110 --> 00:26:38,640

uh so that i'd like to just open it up

742

00:26:45,510 --> 00:26:41,120

for discussion um we've got some

743

00:26:47,669 --> 00:26:45,520

uh questions coming in already um

744

00:26:52,310 --> 00:26:47,679

can we um uh well

745

00:26:55,430 --> 00:26:52,320

should we call it alex uh first alex's

746

00:26:57,269 --> 00:26:55,440

in the air andy you are very staticky if

747

00:27:00,070 --> 00:26:57,279

you're coming in voiceover rp you may

748

00:27:01,510 --> 00:27:00,080

want to hang up and just redial

749

00:27:04,390 --> 00:27:01,520

okay

750

00:27:06,470 --> 00:27:04,400

uh but alex are you on the telecom line

751
00:27:07,909 --> 00:27:06,480
you can ask your question now

752
00:27:09,110 --> 00:27:07,919
yes um

753
00:27:10,070 --> 00:27:09,120
so

754
00:27:12,549 --> 00:27:10,080
uh

755
00:27:13,750 --> 00:27:12,559
can any of everybody hear me i had i

756
00:27:15,110 --> 00:27:13,760
heard static

757
00:27:17,269 --> 00:27:15,120
yeah you're good yeah you're a little

758
00:27:19,269 --> 00:27:17,279
quiet to speak up a bit

759
00:27:21,430 --> 00:27:19,279
all right so um

760
00:27:24,549 --> 00:27:21,440
i think astrobiology community should

761
00:27:27,029 --> 00:27:24,559
reopen debate about uh looking for

762
00:27:29,190 --> 00:27:27,039
extinct versus extant extent searching

763
00:27:31,110 --> 00:27:29,200

for extinct versus extent life on mars i

764

00:27:32,390 --> 00:27:31,120

mean it's the strategies which are

765

00:27:35,590 --> 00:27:32,400

outlined and the requirements are

766

00:27:37,750 --> 00:27:35,600

completely different and it seems like

767

00:27:41,590 --> 00:27:37,760

from the side but by not participating

768

00:27:44,630 --> 00:27:41,600

in this decision making that there is a

769

00:27:46,870 --> 00:27:44,640

kind of implicit

770

00:27:48,070 --> 00:27:46,880

going with looking for the extinct life

771

00:27:50,390 --> 00:27:48,080

you know searching for the asian

772

00:27:52,230 --> 00:27:50,400

biomarkers and going for places for

773

00:27:53,190 --> 00:27:52,240

places where the ancient life would have

774

00:27:55,909 --> 00:27:53,200

been

775

00:27:57,590 --> 00:27:55,919

um and that that's you know focus of

776

00:27:58,630 --> 00:27:57,600

curiosity and

777

00:28:01,110 --> 00:27:58,640

uh

778

00:28:03,190 --> 00:28:01,120

march to 20 and eventually will become

779

00:28:05,190 --> 00:28:03,200

more simple return

780

00:28:06,789 --> 00:28:05,200

i believe in my from my opinion that we

781

00:28:08,230 --> 00:28:06,799

need to step back a little and actually

782

00:28:10,389 --> 00:28:08,240

look is is that

783

00:28:11,830 --> 00:28:10,399

exactly what we want to do you know

784

00:28:13,750 --> 00:28:11,840

because there are certainly a very

785

00:28:16,389 --> 00:28:13,760

strong arguments against

786

00:28:18,389 --> 00:28:16,399

and radiation as primary one against the

787

00:28:20,789 --> 00:28:18,399

uh you know against preservation of

788

00:28:22,310 --> 00:28:20,799

anything complex in the

789

00:28:23,990 --> 00:28:22,320

in the top uh

790

00:28:26,389 --> 00:28:24,000

centimeters of martian soil where we're

791

00:28:27,669 --> 00:28:26,399

going to sample so that concerns me that

792

00:28:30,470 --> 00:28:27,679

we don't even

793

00:28:32,630 --> 00:28:30,480

debate that question that we are

794

00:28:34,149 --> 00:28:32,640

just implicitly going for the extinct

795

00:28:36,310 --> 00:28:34,159

life

796

00:28:37,669 --> 00:28:36,320

thank you

797

00:28:39,430 --> 00:28:37,679

i can read yes

798

00:28:42,470 --> 00:28:39,440

go ahead

799

00:28:44,630 --> 00:28:42,480

well two things one is if you had life

800

00:28:46,389 --> 00:28:44,640

someplace a million years ago and now

801
00:28:47,750 --> 00:28:46,399
you're looking at the remnants of it as

802
00:28:49,590 --> 00:28:47,760
bio signatures

803
00:28:50,870 --> 00:28:49,600
uh even though you're using past life

804
00:28:52,470 --> 00:28:50,880
methods you're actually looking for

805
00:28:54,389 --> 00:28:52,480
evidence of extant life because i would

806
00:28:56,470 --> 00:28:54,399
argue that any evidence of life that was

807
00:28:57,669 --> 00:28:56,480
around in the last few million years

808
00:29:00,470 --> 00:28:57,679
it would be evidence that you have

809
00:29:02,789 --> 00:29:00,480
extant life on mars so a lot of the past

810
00:29:04,950 --> 00:29:02,799
life methodologies i think are relevant

811
00:29:06,870 --> 00:29:04,960
actually to extant life searches

812
00:29:08,389 --> 00:29:06,880
recognizing that where your spacecraft

813
00:29:09,990 --> 00:29:08,399

is sitting at the moment might not be

814

00:29:11,830 --> 00:29:10,000

habitable but if it was habitable in the

815

00:29:13,190 --> 00:29:11,840

last million years or if it reflected

816

00:29:15,029 --> 00:29:13,200

materials from a place that was

817

00:29:16,710 --> 00:29:15,039

habitable in the last million years

818

00:29:17,669 --> 00:29:16,720

you're essentially doing an extant life

819

00:29:19,750 --> 00:29:17,679

search

820

00:29:22,149 --> 00:29:19,760

and making progress on that but i think

821

00:29:23,190 --> 00:29:22,159

another key point i should make

822

00:29:25,029 --> 00:29:23,200

is that

823

00:29:28,149 --> 00:29:25,039

i think a real challenge to people

824

00:29:29,909 --> 00:29:28,159

looking for extant life on mars

825

00:29:32,070 --> 00:29:29,919

is to come up with how do we do the

826

00:29:33,669 --> 00:29:32,080

spacecraft i mean if you want to go to a

827

00:29:35,190 --> 00:29:33,679

high polar latitude and you want to

828

00:29:37,510 --> 00:29:35,200

drill down into the ice how is that

829

00:29:39,510 --> 00:29:37,520

spacecraft going to be last long enough

830

00:29:41,669 --> 00:29:39,520

to do that drilling or how is your

831

00:29:43,750 --> 00:29:41,679

spacecraft going to really be effective

832

00:29:45,830 --> 00:29:43,760

at detecting subsurface environments and

833

00:29:47,269 --> 00:29:45,840

so i i hear you alex i think it's a very

834

00:29:49,430 --> 00:29:47,279

important

835

00:29:51,029 --> 00:29:49,440

topic that deserves more emphasis but

836

00:29:52,470 --> 00:29:51,039

the community really has to start

837

00:29:55,110 --> 00:29:52,480

thinking about the realities of a

838

00:29:58,630 --> 00:29:55,120

spacecraft surviving on on the surface

839

00:30:00,789 --> 00:29:58,640

of mars and and incorporate that into um

840

00:30:03,269 --> 00:30:00,799

you know a plan or a recommendation

841

00:30:05,669 --> 00:30:03,279

another one is these uh recurring slope

842

00:30:07,350 --> 00:30:05,679

linear very exciting potential examples

843

00:30:09,110 --> 00:30:07,360

of fluid in the modern martian

844

00:30:10,950 --> 00:30:09,120

environment but these are very

845

00:30:13,430 --> 00:30:10,960

challenging places they're on slopes

846

00:30:15,510 --> 00:30:13,440

that are unstable and engineers just get

847

00:30:17,510 --> 00:30:15,520

nightmares about being told to drive

848

00:30:19,430 --> 00:30:17,520

into one of those environments and so

849

00:30:21,669 --> 00:30:19,440

how do we actually do the surface

850

00:30:23,590 --> 00:30:21,679

exploration in some of these places so

851

00:30:25,029 --> 00:30:23,600

not to try to say no to any of this but

852

00:30:26,630 --> 00:30:25,039

i think these are the examples of the

853

00:30:29,190 --> 00:30:26,640

challenges that the community has to

854

00:30:32,389 --> 00:30:29,200

begin to address so i agree it does need

855

00:30:36,149 --> 00:30:34,310

so i'm hearing um

856

00:30:38,549 --> 00:30:36,159

sort of bullet point questions and

857

00:30:39,990 --> 00:30:38,559

alex's questions is a point uh that

858

00:30:41,750 --> 00:30:40,000

might be incorporated into the document

859

00:30:43,350 --> 00:30:41,760

which are uh

860

00:30:45,669 --> 00:30:43,360

what what are the type what are the best

861

00:30:47,830 --> 00:30:45,679

places specific places i guess landing

862

00:30:50,070 --> 00:30:47,840

sites on mars that one would go to look

863

00:30:52,070 --> 00:30:50,080

for habitable versus previously

864

00:30:54,950 --> 00:30:52,080

inhabited environments

865

00:30:57,350 --> 00:30:54,960

yeah i mean um just to be more specific

866

00:30:59,590 --> 00:30:57,360

i just want to want to clarify you you

867

00:31:01,430 --> 00:30:59,600

see you bring in point that uh if

868

00:31:03,190 --> 00:31:01,440

something was was out like a million

869

00:31:04,950 --> 00:31:03,200

years and now it's no longer alive then

870

00:31:06,950 --> 00:31:04,960

you can use the same techniques

871

00:31:09,110 --> 00:31:06,960

yet you know uh

872

00:31:10,149 --> 00:31:09,120

for example the state of hydration of

873

00:31:13,830 --> 00:31:10,159

the rocks

874

00:31:15,430 --> 00:31:13,840

you know it might be uh deadly for for

875

00:31:17,510 --> 00:31:15,440

preservation

876

00:31:18,870 --> 00:31:17,520

you know while uh

877

00:31:21,110 --> 00:31:18,880

you know if you're looking for extent

878

00:31:23,750 --> 00:31:21,120

life you want to go where the water is

879

00:31:25,269 --> 00:31:23,760

you know so the basis debate needs to be

880

00:31:26,549 --> 00:31:25,279

still there to clarify but you know

881

00:31:28,070 --> 00:31:26,559

particularly in the application for the

882

00:31:29,830 --> 00:31:28,080

future landing sites

883

00:31:31,830 --> 00:31:29,840

that's that's all

884

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

yeah well please send in some questions

885

00:31:35,990 --> 00:31:34,240

and sort of frame some of this stuff uh

886

00:31:37,509 --> 00:31:36,000

because i yeah i would i think it really

887

00:31:39,590 --> 00:31:37,519

would be important to try to put some of

888

00:31:41,990 --> 00:31:39,600

these challenging questions into the

889

00:31:43,750 --> 00:31:42,000

into the document

890

00:31:46,630 --> 00:31:43,760

okay steve did you want to go down the

891

00:31:48,710 --> 00:31:46,640

list of stuff that's been in the chat or

892

00:31:50,630 --> 00:31:48,720

there yeah i wanted to say with the idea

893

00:31:51,990 --> 00:31:50,640

of adding to the document if you wanted

894

00:31:53,430 --> 00:31:52,000

to put in your bullet point questions

895

00:31:55,669 --> 00:31:53,440

either in the chat or in the document

896

00:31:58,870 --> 00:31:55,679

itself later or i don't i don't know if

897

00:32:00,950 --> 00:31:58,880

it's open now it'd be great so um

898

00:32:03,509 --> 00:32:00,960

yeah just going down the open chat um

899

00:32:05,590 --> 00:32:03,519

britney uh schmidt writes uh

900

00:32:07,110 --> 00:32:05,600

miniaturization uh definitely something

901
00:32:08,630 --> 00:32:07,120
we should be thinking about i think

902
00:32:10,710 --> 00:32:08,640
definitely uh

903
00:32:13,269 --> 00:32:10,720
uh yeah where instrumentation is going

904
00:32:15,830 --> 00:32:13,279
in the next next decade is an exciting

905
00:32:17,669 --> 00:32:15,840
question to ask about um

906
00:32:18,470 --> 00:32:17,679
how we how the types of questions we can

907
00:32:22,230 --> 00:32:18,480
ask

908
00:32:23,430 --> 00:32:22,240
will change during that time um

909
00:32:25,990 --> 00:32:23,440
right and brittany also raises the

910
00:32:27,269 --> 00:32:26,000
points or suggests uh we're not going to

911
00:32:28,549 --> 00:32:27,279
be able to return samples from

912
00:32:30,310 --> 00:32:28,559
everywhere but we can send more

913
00:32:33,990 --> 00:32:30,320

sophisticated instruments outward i

914

00:32:36,630 --> 00:32:34,000

guess that's a that's a comment about um

915

00:32:40,789 --> 00:32:38,470

maybe the breadth of science that might

916

00:32:43,110 --> 00:32:40,799

be returned uh from focused uh

917

00:32:45,350 --> 00:32:43,120

exploration missions versus the the

918

00:32:47,990 --> 00:32:45,360

level of input needed uh for sample

919

00:32:51,350 --> 00:32:49,430

did you you just made a comment about

920

00:32:52,389 --> 00:32:51,360

brittany's second comment there about

921

00:32:55,509 --> 00:32:52,399

yeah

922

00:32:58,870 --> 00:32:55,519

here

923

00:33:01,110 --> 00:32:58,880

lot of uncertainty about which objects

924

00:33:03,350 --> 00:33:01,120

are going to be higher next ones being

925

00:33:05,190 --> 00:33:03,360

addressed and the politics of it all and

926
00:33:06,950 --> 00:33:05,200
everything but one thing that could be

927
00:33:09,430 --> 00:33:06,960
generic that would be worth thinking

928
00:33:10,950 --> 00:33:09,440
about it's just instrument development

929
00:33:12,310 --> 00:33:10,960
one of the reasons i put that list of

930
00:33:13,909 --> 00:33:12,320
measurements in there is to think in

931
00:33:15,190 --> 00:33:13,919
terms of generic measurements that would

932
00:33:18,149 --> 00:33:15,200
be useful

933
00:33:20,870 --> 00:33:18,159
at an at a number of destinations uh and

934
00:33:22,870 --> 00:33:20,880
and that if the astrobiology community

935
00:33:24,549 --> 00:33:22,880
you know advocated for some more

936
00:33:25,990 --> 00:33:24,559
development in some of these

937
00:33:28,149 --> 00:33:26,000
by whatever means

938
00:33:30,549 --> 00:33:28,159

uh that would be a good investment

939

00:33:32,950 --> 00:33:30,559

regardless of which missions turn out to

940

00:33:34,149 --> 00:33:32,960

be highest in the queue so

941

00:33:36,310 --> 00:33:34,159

instrument development doesn't

942

00:33:38,630 --> 00:33:36,320

necessarily have to be target specific

943

00:33:40,870 --> 00:33:38,640

and and you know figuring out how to

944

00:33:42,710 --> 00:33:40,880

prioritize and advocate in a way that

945

00:33:44,389 --> 00:33:42,720

you're always ready for the the key

946

00:33:48,710 --> 00:33:44,399

mission when it comes along i think is a

947

00:33:53,190 --> 00:33:50,710

just in case anyone didn't see the

948

00:33:56,710 --> 00:33:53,200

comment i put in the text box uh the

949

00:33:59,269 --> 00:33:56,720

document is now open for commenting so

950

00:34:01,110 --> 00:33:59,279

if you want to um just in case anyone

951
00:34:03,509 --> 00:34:01,120
hasn't done it before the process is you

952
00:34:05,269 --> 00:34:03,519
just highlight a piece of text choose

953
00:34:07,430 --> 00:34:05,279
comment from your right click menu and

954
00:34:10,389 --> 00:34:07,440
you can stick the virtual post-it notes

955
00:34:13,270 --> 00:34:11,510
okay

956
00:34:15,109 --> 00:34:13,280
john rummel made a number of comments i

957
00:34:17,909 --> 00:34:15,119
don't know steve did you wanna have you

958
00:34:20,310 --> 00:34:17,919
read those let's see uh yeah

959
00:34:26,069 --> 00:34:20,320
um

960
00:34:28,470 --> 00:34:26,079
john made was a 2020 mission will be the

961
00:34:31,030 --> 00:34:28,480
first on the trio that could bring uh

962
00:34:32,149 --> 00:34:31,040
that to mars um

963
00:34:33,909 --> 00:34:32,159

that's kind of the line with what you

964

00:34:35,589 --> 00:34:33,919

were saying dave about where mars

965

00:34:37,750 --> 00:34:35,599

exploration might be headed

966

00:34:39,669 --> 00:34:37,760

um

967

00:34:41,669 --> 00:34:39,679

yeah well the key point from john is

968

00:34:43,109 --> 00:34:41,679

regarding you know science or not the

969

00:34:44,869 --> 00:34:43,119

any sample that comes back will be

970

00:34:48,069 --> 00:34:44,879

looked for present-day life for

971

00:34:49,430 --> 00:34:48,079

planetary protection requirements so uh

972

00:34:51,430 --> 00:34:49,440

but again that

973

00:34:53,109 --> 00:34:51,440

you get getting to alex's point you know

974

00:34:54,710 --> 00:34:53,119

where you pick that sample from

975

00:34:55,589 --> 00:34:54,720

certainly will affect

976

00:34:56,629 --> 00:34:55,599

you know

977

00:34:59,190 --> 00:34:56,639

probably have an effect on the

978

00:35:01,190 --> 00:34:59,200

probability that extant life would be

979

00:35:03,109 --> 00:35:01,200

somehow reflected in that

980

00:35:05,349 --> 00:35:03,119

um you know

981

00:35:06,390 --> 00:35:05,359

so there's a selection of sample thing

982

00:35:08,069 --> 00:35:06,400

that uh

983

00:35:10,630 --> 00:35:08,079

you know that might uh

984

00:35:13,190 --> 00:35:10,640

weigh in but in any case all samples

985

00:35:14,829 --> 00:35:13,200

will be checked for extend life as a

986

00:35:17,510 --> 00:35:14,839

requirement

987

00:35:19,430 --> 00:35:17,520

um so let's see and he says giving

988

00:35:23,109 --> 00:35:19,440

engineers nightmares is not a bad thing

989

00:35:24,790 --> 00:35:23,119

sometimes it's required well okay

990

00:35:26,630 --> 00:35:24,800

well especially when you want to bring

991

00:35:27,589 --> 00:35:26,640

back a sample that's clean enough to be

992

00:35:30,470 --> 00:35:27,599

looked at

993

00:35:33,030 --> 00:35:30,480

for non-florida life

994

00:35:34,150 --> 00:35:33,040

yeah there you go

995

00:35:36,550 --> 00:35:34,160

exactly

996

00:35:38,390 --> 00:35:36,560

okay an additional perspective tying in

997

00:35:40,470 --> 00:35:38,400

elsewhere john do you just want to

998

00:35:43,030 --> 00:35:40,480

comment to it since you're right there

999

00:35:45,190 --> 00:35:43,040

uh yeah it's just that uh you know

1000

00:35:47,109 --> 00:35:45,200

oftentimes we think about habitable

1001
00:35:48,470 --> 00:35:47,119
zones as places where we would be

1002
00:35:53,270 --> 00:35:48,480
comfortable

1003
00:35:54,950 --> 00:35:53,280
um i think that we tend to even though

1004
00:35:56,150 --> 00:35:54,960
we shouldn't

1005
00:35:58,550 --> 00:35:56,160
neglect

1006
00:36:00,069 --> 00:35:58,560
sometimes deep sea type organisms and

1007
00:36:01,510 --> 00:36:00,079
other kinds

1008
00:36:04,550 --> 00:36:01,520
and if you look at

1009
00:36:05,510 --> 00:36:04,560
where organisms might be formed in an

1010
00:36:06,550 --> 00:36:05,520
origin

1011
00:36:08,470 --> 00:36:06,560
endeavor

1012
00:36:10,150 --> 00:36:08,480
they may be at these highly energetic

1013
00:36:12,550 --> 00:36:10,160

and very

1014

00:36:15,589 --> 00:36:12,560

episodic kinds of places

1015

00:36:18,230 --> 00:36:15,599

but where life proliferates and maybe in

1016

00:36:20,069 --> 00:36:18,240

greater abundance could be places where

1017

00:36:22,950 --> 00:36:20,079

you could never actually have an origin

1018

00:36:25,349 --> 00:36:22,960

of life but are nice materially

1019

00:36:27,910 --> 00:36:25,359

sufficient and energetically

1020

00:36:29,270 --> 00:36:27,920

available type places like a warm little

1021

00:36:31,910 --> 00:36:29,280

pool

1022

00:36:34,870 --> 00:36:31,920

so i i do think that there's a tie-in

1023

00:36:37,670 --> 00:36:34,880

to the origin of life group

1024

00:36:39,190 --> 00:36:37,680

because something that might be

1025

00:36:41,030 --> 00:36:39,200

challenging

1026
00:36:41,910 --> 00:36:41,040
but habitable

1027
00:36:45,030 --> 00:36:41,920
say

1028
00:36:48,390 --> 00:36:45,040
a deep aquifer on mars that's exposed to

1029
00:36:51,829 --> 00:36:48,400
some of the weight and volcanism

1030
00:36:56,470 --> 00:36:51,839
might not be the place to go looking for

1031
00:36:58,870 --> 00:36:57,349
yeah

1032
00:37:02,069 --> 00:36:58,880
this reminds me of another key

1033
00:37:04,630 --> 00:37:02,079
perspective and that is that

1034
00:37:06,150 --> 00:37:04,640
the role that

1035
00:37:08,310 --> 00:37:06,160
the characterization of a habitable

1036
00:37:10,470 --> 00:37:08,320
environment has in supporting the

1037
00:37:12,550 --> 00:37:10,480
detection of biosignatures and what i

1038
00:37:14,470 --> 00:37:12,560

mean by that is that if you have a

1039

00:37:15,990 --> 00:37:14,480

habitable environment or as john was

1040

00:37:17,750 --> 00:37:16,000

talking about an environment in which

1041

00:37:19,190 --> 00:37:17,760

life could begin

1042

00:37:20,630 --> 00:37:19,200

you're probably talking about an

1043

00:37:22,390 --> 00:37:20,640

environment that's going to create a lot

1044

00:37:23,510 --> 00:37:22,400

of features that might mimic bio

1045

00:37:25,430 --> 00:37:23,520

signatures

1046

00:37:27,829 --> 00:37:25,440

and so in a way

1047

00:37:30,150 --> 00:37:27,839

that establishing a bias something as a

1048

00:37:32,950 --> 00:37:30,160

definitive bio signature is an exercise

1049

00:37:34,950 --> 00:37:32,960

in signal to noise the signal is the is

1050

00:37:36,390 --> 00:37:34,960

the life created feature the noise is

1051

00:37:38,790 --> 00:37:36,400

all the other stuff that that

1052

00:37:41,430 --> 00:37:38,800

environment creates as chemical or

1053

00:37:43,589 --> 00:37:41,440

mineralogical background and you have to

1054

00:37:46,230 --> 00:37:43,599

resolve your biosignature signal against

1055

00:37:48,870 --> 00:37:46,240

that inhabitable environment noise and

1056

00:37:50,710 --> 00:37:48,880

so just as a process of detecting bio

1057

00:37:53,589 --> 00:37:50,720

signatures you've got to characterize

1058

00:37:55,430 --> 00:37:53,599

your noisy background and of course as

1059

00:37:57,670 --> 00:37:55,440

you're talking if you're talking about a

1060

00:37:59,910 --> 00:37:57,680

place where life could begin you're

1061

00:38:01,829 --> 00:37:59,920

talking about a place where a sequence

1062

00:38:03,750 --> 00:38:01,839

of events is leading up to life and

1063

00:38:05,589 --> 00:38:03,760

that's a gray zone between the

1064

00:38:08,069 --> 00:38:05,599

non-living and the living and we've got

1065

00:38:09,750 --> 00:38:08,079

to be prepared how to navigate that so

1066

00:38:11,270 --> 00:38:09,760

how do you what kind of chemical organic

1067

00:38:13,430 --> 00:38:11,280

chemical measurements do you make what

1068

00:38:15,670 --> 00:38:13,440

types of observations do you make to

1069

00:38:17,349 --> 00:38:15,680

sort of help you figure out you know

1070

00:38:18,630 --> 00:38:17,359

what the sources are of all these

1071

00:38:21,190 --> 00:38:18,640

interesting features that you're going

1072

00:38:23,270 --> 00:38:21,200

to be confronted with so right we're so

1073

00:38:25,910 --> 00:38:23,280

good at defining we're so good at

1074

00:38:27,270 --> 00:38:25,920

defining where life starts too

1075

00:38:29,109 --> 00:38:27,280

right exactly

1076

00:38:30,870 --> 00:38:29,119

and so you know

1077

00:38:32,790 --> 00:38:30,880

part of this is something that can get

1078

00:38:34,950 --> 00:38:32,800

you very enthusiastic about making

1079

00:38:37,990 --> 00:38:34,960

organic chemical measurements because as

1080

00:38:40,470 --> 00:38:38,000

we all know organic chemistry is so rich

1081

00:38:42,950 --> 00:38:40,480

in its information content that it's a

1082

00:38:44,870 --> 00:38:42,960

great indicator of process

1083

00:38:47,990 --> 00:38:44,880

but at the same time it's also

1084

00:38:49,670 --> 00:38:48,000

challenging to interpret and sending

1085

00:38:51,510 --> 00:38:49,680

instruments to other planets that can

1086

00:38:53,589 --> 00:38:51,520

really get into the details of organic

1087

00:38:55,750 --> 00:38:53,599

chemistry these are complex instruments

1088

00:38:58,150 --> 00:38:55,760

and i think certainly for mars and

1089

00:38:59,910 --> 00:38:58,160

probably for all objects a big challenge

1090

00:39:01,430 --> 00:38:59,920

for the astrobiology community is how do

1091

00:39:03,510 --> 00:39:01,440

we get more effective at organic

1092

00:39:06,870 --> 00:39:03,520

detection and characterization in

1093

00:39:11,270 --> 00:39:09,670

uh sean demogal goldman raised a couple

1094

00:39:14,470 --> 00:39:11,280

of i think related points but a nice

1095

00:39:17,030 --> 00:39:14,480

discussion going on about how in-situ

1096

00:39:18,550 --> 00:39:17,040

exploration on earth

1097

00:39:19,910 --> 00:39:18,560

could inform

1098

00:39:23,109 --> 00:39:19,920

the types of more comprehensive

1099

00:39:25,589 --> 00:39:23,119

investigations uh might be needed uh i'm

1100

00:39:29,109 --> 00:39:25,599

just trying to summarize here from my

1101

00:39:32,150 --> 00:39:29,119

understanding and sean's point is um

1102

00:39:34,470 --> 00:39:32,160

you consider um either in the context of

1103

00:39:36,630 --> 00:39:34,480

exoplanets which are even harder in the

1104

00:39:39,030 --> 00:39:36,640

search for habitability uh but think of

1105

00:39:41,349 --> 00:39:39,040

you know an ice cover covered world uh

1106

00:39:43,589 --> 00:39:41,359

like europa or enceladus

1107

00:39:46,310 --> 00:39:43,599

you're looking for surface communication

1108

00:39:48,470 --> 00:39:46,320

or the signature of habitability um

1109

00:39:50,470 --> 00:39:48,480

you're presented with uh with challenges

1110

00:39:52,630 --> 00:39:50,480

of understanding uh how those signatures

1111

00:39:54,470 --> 00:39:52,640

evolve but also how to make suited

1112

00:39:55,910 --> 00:39:54,480

measurements that'll be necessary

1113

00:39:58,069 --> 00:39:55,920

to understand habitability in that

1114

00:40:00,230 --> 00:39:58,079

context

1115

00:40:02,390 --> 00:40:00,240

i think that touches on the same kinds

1116

00:40:04,230 --> 00:40:02,400

of issues of organic detection that dave

1117

00:40:05,990 --> 00:40:04,240

was describing as well

1118

00:40:07,910 --> 00:40:06,000

yeah so i mean a key point is that

1119

00:40:10,310 --> 00:40:07,920

organic matter can be a wonderfully

1120

00:40:12,310 --> 00:40:10,320

detailed environmental indicator but it

1121

00:40:14,230 --> 00:40:12,320

but the astrobiology community is really

1122

00:40:16,390 --> 00:40:14,240

the only community out there that is

1123

00:40:17,750 --> 00:40:16,400

advocating strongly for organic

1124

00:40:20,550 --> 00:40:17,760

measurements and spacecraft at the

1125

00:40:21,750 --> 00:40:20,560

moment uh and so there's there's a key

1126

00:40:24,630 --> 00:40:21,760

niche that

1127

00:40:26,390 --> 00:40:24,640

the astrobiology community could

1128

00:40:33,430 --> 00:40:26,400

could provide for

1129

00:40:36,390 --> 00:40:34,790

and you know organic chemistry

1130

00:40:37,990 --> 00:40:36,400

especially in the outer solar system is

1131

00:40:43,990 --> 00:40:38,000

it just an indicator processing

1132

00:40:48,310 --> 00:40:46,630

do you want to take any of these text

1133

00:40:49,750 --> 00:40:48,320

chats onto

1134

00:40:53,430 --> 00:40:49,760

the voice

1135

00:40:56,069 --> 00:40:53,440

we just lost steve uh oh no you just

1136

00:40:59,670 --> 00:40:56,079

missed your thing uh yeah my my video

1137

00:41:01,910 --> 00:40:59,680

just reset for some some reason um

1138

00:41:07,190 --> 00:41:01,920

well let's see jen you you made quite a

1139

00:41:11,109 --> 00:41:09,430

uh you're referring to my comment dave

1140

00:41:13,589 --> 00:41:11,119

well yeah anything you want to say you

1141

00:41:16,710 --> 00:41:13,599

just you're making a lot of comments

1142

00:41:18,870 --> 00:41:16,720

yeah um one was um in the big picture

1143

00:41:20,870 --> 00:41:18,880

you know when we go to a planet we have

1144

00:41:22,950 --> 00:41:20,880

a limited set of instruments and we have

1145

00:41:25,430 --> 00:41:22,960

a limited amount of time

1146

00:41:27,670 --> 00:41:25,440

resources to study whatever it is

1147

00:41:29,430 --> 00:41:27,680

respond to study we have specific

1148

00:41:31,589 --> 00:41:29,440

questions outlined everything was

1149

00:41:33,030 --> 00:41:31,599

tailored towards that but

1150

00:41:35,670 --> 00:41:33,040

in the big picture

1151

00:41:38,470 --> 00:41:35,680

that planetary in situ science has

1152

00:41:41,190 --> 00:41:38,480

severe limitations in comparison to what

1153

00:41:42,950 --> 00:41:41,200

we do on earth now on earth we go to the

1154

00:41:44,870 --> 00:41:42,960

field or we do something in the lab and

1155

00:41:47,829 --> 00:41:44,880

we can sample you know to our hearts

1156

00:41:50,230 --> 00:41:47,839

content and make analyses that are

1157

00:41:53,270 --> 00:41:50,240

made on a variety of instruments as many

1158

00:41:55,270 --> 00:41:53,280

num many analyses as we want

1159

00:41:56,550 --> 00:41:55,280

and uh on instruments that have higher

1160

00:41:59,510 --> 00:41:56,560

sensitivity

1161

00:42:02,470 --> 00:41:59,520

there is a complete disconnect

1162

00:42:04,390 --> 00:42:02,480

between those two types of

1163

00:42:05,270 --> 00:42:04,400

science approaches

1164

00:42:08,150 --> 00:42:05,280

and

1165

00:42:11,109 --> 00:42:08,160

i think that uh planetary in situ

1166

00:42:12,390 --> 00:42:11,119

science would strongly benefit from

1167

00:42:14,710 --> 00:42:12,400

people

1168

00:42:17,349 --> 00:42:14,720

doing the comprehensive studies on earth

1169

00:42:19,750 --> 00:42:17,359

and and reflecting at what a high

1170

00:42:22,150 --> 00:42:19,760

fidelity planetary in situ science would

1171

00:42:23,829 --> 00:42:22,160

have provided as far as information goes

1172

00:42:25,829 --> 00:42:23,839

and how we interpret that

1173

00:42:27,589 --> 00:42:25,839

and it's something that it's challenging

1174

00:42:32,150 --> 00:42:27,599

to do

1175

00:42:36,470 --> 00:42:34,150

so a nice example of synergy between

1176

00:42:37,829 --> 00:42:36,480

earth-based and

1177

00:42:41,190 --> 00:42:37,839

research and

1178

00:42:44,710 --> 00:42:43,589

yeah another thought i had was um and

1179

00:42:46,790 --> 00:42:44,720

this is

1180

00:42:48,470 --> 00:42:46,800

uh this this kind of stems from my own

1181

00:42:50,150 --> 00:42:48,480

phd research

1182

00:42:51,030 --> 00:42:50,160

is that uh you know

1183

00:42:58,309 --> 00:42:51,040

we

1184

00:42:59,829 --> 00:42:58,319

signatures are

1185

00:43:01,030 --> 00:42:59,839

uh when we talk about extraterrestrial

1186

00:43:03,030 --> 00:43:01,040

life we don't know what those bio

1187

00:43:04,710 --> 00:43:03,040

signatures are we're taking a guess

1188

00:43:05,670 --> 00:43:04,720

based on earth

1189

00:43:07,430 --> 00:43:05,680

and

1190

00:43:09,270 --> 00:43:07,440

perhaps

1191

00:43:10,790 --> 00:43:09,280

those aren't going to be the right ones

1192

00:43:11,829 --> 00:43:10,800

and so

1193

00:43:14,550 --> 00:43:11,839

when

1194

00:43:16,550 --> 00:43:14,560

in the long run unless there's some

1195

00:43:18,870 --> 00:43:16,560

martian out there waving at us saying

1196

00:43:20,230 --> 00:43:18,880

hello i'm not so sure that a buyer's

1197

00:43:21,750 --> 00:43:20,240

signature is going to convince us that

1198

00:43:22,950 --> 00:43:21,760

we have evidence of extraterrestrial

1199

00:43:24,550 --> 00:43:22,960

life

1200

00:43:27,829 --> 00:43:24,560

we don't know yet it depends on what we

1201
00:43:29,270 --> 00:43:27,839
find but the thing that is so unique

1202
00:43:30,790 --> 00:43:29,280
about life is it's part of this

1203
00:43:33,109 --> 00:43:30,800
ecosystem

1204
00:43:34,630 --> 00:43:33,119
and it has interactions with the rest of

1205
00:43:37,910 --> 00:43:34,640
the environment around it and it leaves

1206
00:43:39,670 --> 00:43:37,920
a record of that in both the um extinct

1207
00:43:43,510 --> 00:43:39,680
as what the recorded as well as the

1208
00:43:45,829 --> 00:43:43,520
expanse environment and so perhaps

1209
00:43:47,750 --> 00:43:45,839
the way we will convince ourselves of

1210
00:43:50,790 --> 00:43:47,760
the presence of extraterrestrial life

1211
00:43:53,910 --> 00:43:50,800
will be to understand that ecosystem

1212
00:43:55,270 --> 00:43:53,920
or the record of it and so this is very

1213
00:43:56,309 --> 00:43:55,280

much part of

1214

00:43:57,990 --> 00:43:56,319

uh

1215

00:44:00,550 --> 00:43:58,000

i should say the approach we have been

1216

00:44:01,910 --> 00:44:00,560

taking to planetary science i think fits

1217

00:44:10,390 --> 00:44:01,920

this

1218

00:44:14,630 --> 00:44:12,309

so in a way i mean one thing you know

1219

00:44:16,870 --> 00:44:14,640

you can do is go to a go to an object

1220

00:44:18,390 --> 00:44:16,880

and begin to characterize the past and

1221

00:44:20,069 --> 00:44:18,400

present environment there and you just

1222

00:44:22,550 --> 00:44:20,079

keep characterizing it you have a model

1223

00:44:23,990 --> 00:44:22,560

about the processes and and and so forth

1224

00:44:25,670 --> 00:44:24,000

that are involved

1225

00:44:27,190 --> 00:44:25,680

and you just do that and you and at some

1226
00:44:29,190 --> 00:44:27,200
point you suddenly start coming up with

1227
00:44:31,430 --> 00:44:29,200
features that you can't explain by your

1228
00:44:34,390 --> 00:44:31,440
model which is basically based on

1229
00:44:35,990 --> 00:44:34,400
non-biological process and of course and

1230
00:44:37,910 --> 00:44:36,000
this is the way to be perhaps most

1231
00:44:39,430 --> 00:44:37,920
objective about

1232
00:44:40,870 --> 00:44:39,440
confronting the possibility that you've

1233
00:44:42,870 --> 00:44:40,880
got a bio signature because the

1234
00:44:44,950 --> 00:44:42,880
definition of a biosignature is a

1235
00:44:46,870 --> 00:44:44,960
something that requires a biological

1236
00:44:48,870 --> 00:44:46,880
process so if you can't explain

1237
00:44:51,030 --> 00:44:48,880
something with non-biological processes

1238
00:44:52,790 --> 00:44:51,040

you might be on to onto something here

1239

00:44:54,309 --> 00:44:52,800

in terms of your search for a

1240

00:44:55,910 --> 00:44:54,319

biosignature so

1241

00:44:57,910 --> 00:44:55,920

again you know the search for

1242

00:44:59,829 --> 00:44:57,920

biosignatures in my view goes through

1243

00:45:01,829 --> 00:44:59,839

the neighborhood of characterizing the

1244

00:45:04,950 --> 00:45:01,839

environment the extent to which it might

1245

00:45:06,550 --> 00:45:04,960

be habitable and then having a model to

1246

00:45:09,430 --> 00:45:06,560

explain what you're seeing and then as

1247

00:45:10,309 --> 00:45:09,440

you move forward you may or may not be

1248

00:45:12,069 --> 00:45:10,319

uh

1249

00:45:13,670 --> 00:45:12,079

getting closer to detecting evidence of

1250

00:45:15,670 --> 00:45:13,680

life yeah and i think i think there was

1251

00:45:18,069 --> 00:45:15,680

a request to to split this into two

1252

00:45:20,150 --> 00:45:18,079

documents focusing on habitability and

1253

00:45:22,150 --> 00:45:20,160

also on life detection because uh

1254

00:45:24,630 --> 00:45:22,160

habitability is such a such a broad

1255

00:45:26,790 --> 00:45:24,640

issue it's something we're really

1256

00:45:28,470 --> 00:45:26,800

trying to understand and planetary

1257

00:45:31,589 --> 00:45:28,480

science

1258

00:45:33,589 --> 00:45:31,599

has a huge set of tools that can allow

1259

00:45:35,510 --> 00:45:33,599

us to understand the chemistry of the

1260

00:45:39,270 --> 00:45:35,520

solar system the the origin of the

1261

00:45:44,150 --> 00:45:42,309

have a long progression

1262

00:45:46,470 --> 00:45:44,160

that goes from

1263

00:45:49,270 --> 00:45:46,480

chemistry not directly related to life

1264

00:45:54,630 --> 00:45:49,280

to eventually creating the conditions

1265

00:45:59,990 --> 00:45:57,589

okay sean made a key point and um i

1266

00:46:02,230 --> 00:46:00,000

think i want to respond to that but

1267

00:46:04,550 --> 00:46:02,240

let's see sean why don't you can you put

1268

00:46:07,190 --> 00:46:04,560

your comments into words

1269

00:46:08,470 --> 00:46:07,200

and then yeah yeah i mean i i i think

1270

00:46:10,230 --> 00:46:08,480

you guys have been making great points

1271

00:46:11,030 --> 00:46:10,240

and i don't want to imply that you

1272

00:46:13,829 --> 00:46:11,040

weren't

1273

00:46:15,750 --> 00:46:13,839

um or that you were suggesting this but

1274

00:46:17,670 --> 00:46:15,760

i just want to make sure that we also

1275

00:46:18,630 --> 00:46:17,680

have space in the document

1276

00:46:20,309 --> 00:46:18,640

for

1277

00:46:22,790 --> 00:46:20,319

research that isn't directly tied to

1278

00:46:24,390 --> 00:46:22,800

near-term measure right this we need to

1279

00:46:26,550 --> 00:46:24,400

do that so that we

1280

00:46:28,309 --> 00:46:26,560

provide the motivations for measurements

1281

00:46:30,790 --> 00:46:28,319

further out on the horizon than the next

1282

00:46:32,390 --> 00:46:30,800

decade or two decades and sometimes we

1283

00:46:34,309 --> 00:46:32,400

need things that will never be measured

1284

00:46:35,750 --> 00:46:34,319

to provide context for the measurements

1285

00:46:37,510 --> 00:46:35,760

we can make

1286

00:46:39,430 --> 00:46:37,520

and to just do the fundamental science

1287

00:46:41,270 --> 00:46:39,440

of how these planets operate and how

1288

00:46:43,270 --> 00:46:41,280

life might operate or have operated on

1289

00:46:44,870 --> 00:46:43,280

those planets um sometimes these things

1290

00:46:46,550 --> 00:46:44,880

just aren't uh aren't amenable to

1291

00:46:48,470 --> 00:46:46,560

measurement at all but

1292

00:46:52,390 --> 00:46:48,480

we should still be doing them not not

1293

00:46:55,589 --> 00:46:53,190

yeah

1294

00:46:57,349 --> 00:46:55,599

two responses i absolutely agree with

1295

00:46:59,030 --> 00:46:57,359

you that this should not be a focus only

1296

00:47:01,030 --> 00:46:59,040

on near term that we should be looking

1297

00:47:02,870 --> 00:47:01,040

at the far term but at the same time

1298

00:47:05,270 --> 00:47:02,880

this particular topic that we're

1299

00:47:07,510 --> 00:47:05,280

discussing today really is mission

1300

00:47:09,349 --> 00:47:07,520

oriented uh and i think that's what

1301
00:47:11,510 --> 00:47:09,359
differentiates it from some of the other

1302
00:47:13,910 --> 00:47:11,520
topic groups which deal with like basics

1303
00:47:15,030 --> 00:47:13,920
of habitability and and all of that this

1304
00:47:17,589 --> 00:47:15,040
is really

1305
00:47:19,349 --> 00:47:17,599
applying astrobiology to missions

1306
00:47:21,270 --> 00:47:19,359
although i totally agree that it should

1307
00:47:24,309 --> 00:47:21,280
be off into the future

1308
00:47:26,309 --> 00:47:24,319
as far out as we could conceptualize

1309
00:47:30,230 --> 00:47:26,319
you know just to keep it keep it open in

1310
00:47:36,390 --> 00:47:33,670
dave do you see john's point just in the

1311
00:47:37,109 --> 00:47:36,400
chat window

1312
00:47:38,870 --> 00:47:37,119
uh

1313
00:47:41,589 --> 00:47:38,880

john you want to

1314

00:47:43,990 --> 00:47:41,599

verbalize that

1315

00:47:47,190 --> 00:47:44,000

oh just that uh we're looking at special

1316

00:47:48,630 --> 00:47:47,200

regions on mars as potential habitats

1317

00:47:50,710 --> 00:47:48,640

and uh so

1318

00:47:54,790 --> 00:47:50,720

looking forward to putting together an

1319

00:47:56,710 --> 00:47:54,800

effort that will update the definitions

1320

00:47:59,349 --> 00:47:56,720

and possibly

1321

00:48:02,630 --> 00:47:59,359

do a better job of locating

1322

00:48:05,430 --> 00:48:02,640

features that might lead us to believe

1323

00:48:07,109 --> 00:48:05,440

that those special region definitions

1324

00:48:08,550 --> 00:48:07,119

could actually be

1325

00:48:10,150 --> 00:48:08,560

inclusive

1326

00:48:12,870 --> 00:48:10,160

at those places

1327

00:48:14,069 --> 00:48:12,880

so rsls for example are you already

1328

00:48:15,750 --> 00:48:14,079

mentioned

1329

00:48:17,510 --> 00:48:15,760

but those are places where there may in

1330

00:48:20,950 --> 00:48:17,520

fact be

1331

00:48:23,589 --> 00:48:20,960

liquid water at cold temperatures with a

1332

00:48:25,750 --> 00:48:23,599

large briny content

1333

00:48:27,829 --> 00:48:25,760

and then the question is you know is

1334

00:48:28,630 --> 00:48:27,839

there an earth organism that can live in

1335

00:48:30,309 --> 00:48:28,640

there

1336

00:48:32,470 --> 00:48:30,319

we don't define

1337

00:48:34,870 --> 00:48:32,480

special regions on the basis of martian

1338

00:48:36,390 --> 00:48:34,880

organisms but certainly those would be

1339

00:48:38,309 --> 00:48:36,400

places to look

1340

00:48:40,950 --> 00:48:38,319

if we were going to go start looking for

1341

00:48:42,630 --> 00:48:40,960

martian organisms but anyway that's just

1342

00:48:44,069 --> 00:48:42,640

something that's going to happen over

1343

00:48:44,870 --> 00:48:44,079

the next year

1344

00:48:48,790 --> 00:48:44,880

and

1345

00:48:50,630 --> 00:48:48,800

i thought i'd throw that into the mix

1346

00:48:52,309 --> 00:48:50,640

yeah so i just a general comment from me

1347

00:48:54,710 --> 00:48:52,319

is that planetary protection really

1348

00:48:55,990 --> 00:48:54,720

addresses legal requirements and and you

1349

00:48:58,230 --> 00:48:56,000

know some just

1350

00:49:00,309 --> 00:48:58,240

proper housekeeping that we need to do

1351

00:49:02,150 --> 00:49:00,319

with exploration but there is this

1352

00:49:03,670 --> 00:49:02,160

really i think substantive link between

1353

00:49:05,430 --> 00:49:03,680

planetary protection and search for

1354

00:49:07,349 --> 00:49:05,440

extant life because

1355

00:49:09,670 --> 00:49:07,359

you know that's sort of the essence of

1356

00:49:11,829 --> 00:49:09,680

the phenomenon that both of these uh

1357

00:49:13,990 --> 00:49:11,839

topics are addressing and so there could

1358

00:49:14,829 --> 00:49:14,000

be some synergy there in terms of

1359

00:49:17,190 --> 00:49:14,839

future

1360

00:49:19,109 --> 00:49:17,200

activities this is seen again do you

1361

00:49:20,549 --> 00:49:19,119

guys mind if i just jump in for a minute

1362

00:49:22,309 --> 00:49:20,559

sure

1363

00:49:24,549 --> 00:49:22,319

so i just want to give an example of the

1364

00:49:27,190 --> 00:49:24,559

type of thing i'm talking about um with

1365

00:49:29,510 --> 00:49:27,200

with maybe non-mission uh solar system

1366

00:49:31,430 --> 00:49:29,520

habitability topics of research

1367

00:49:33,510 --> 00:49:31,440

and this is this is target specific and

1368

00:49:35,190 --> 00:49:33,520

i don't mean to mention this target to

1369

00:49:36,150 --> 00:49:35,200

the exclusion of other ideas just as an

1370

00:49:37,829 --> 00:49:36,160

example

1371

00:49:39,829 --> 00:49:37,839

imagine the the

1372

00:49:42,150 --> 00:49:39,839

hypothesis that there's a potential

1373

00:49:44,230 --> 00:49:42,160

double biosphere on titan where one at

1374

00:49:46,549 --> 00:49:44,240

the surface in these methane ethane

1375

00:49:49,829 --> 00:49:46,559

organic lakes and then a second in a

1376

00:49:51,670 --> 00:49:49,839

deep deep subsurface water layer now

1377

00:49:53,430 --> 00:49:51,680

whether or not that deep subsurface

1378

00:49:55,430 --> 00:49:53,440

water layer is habitable or not i think

1379

00:49:56,829 --> 00:49:55,440

is something that we should be exploring

1380

00:49:59,190 --> 00:49:56,839

as a community of

1381

00:50:01,030 --> 00:49:59,200

astrobiologists um even though i don't

1382

00:50:02,710 --> 00:50:01,040

see any prospects even in the next

1383

00:50:04,230 --> 00:50:02,720

century for testing that with

1384

00:50:07,190 --> 00:50:04,240

instrumentation

1385

00:50:09,109 --> 00:50:07,200

but i don't we should be excluding that

1386

00:50:11,430 --> 00:50:09,119

looking at that from a theoretical

1387

00:50:12,870 --> 00:50:11,440

perspective because as a community we

1388

00:50:14,309 --> 00:50:12,880

really should be the one i mean if we're

1389

00:50:17,030 --> 00:50:14,319

not going to cover that first off who

1390

00:50:19,510 --> 00:50:17,040

else is and secondly if one of the goals

1391

00:50:21,270 --> 00:50:19,520

of astrobiology is to put together a

1392

00:50:23,030 --> 00:50:21,280

list of all the places that alien life

1393

00:50:24,710 --> 00:50:23,040

might crop up that's one of them and we

1394

00:50:27,510 --> 00:50:24,720

should be exploring that as rigorously

1395

00:50:30,470 --> 00:50:27,520

as we can without uh you know a super

1396

00:50:32,309 --> 00:50:30,480

drill going to titan and and going down

1397

00:50:33,430 --> 00:50:32,319

to that second potentially habitable

1398

00:50:35,349 --> 00:50:33,440

layer

1399

00:50:37,109 --> 00:50:35,359

so let me respond to my perspective uh

1400

00:50:38,549 --> 00:50:37,119

sean you're speaking about a topic

1401

00:50:41,030 --> 00:50:38,559

that's very close to my heart in my

1402

00:50:42,390 --> 00:50:41,040

poster at agu um

1403

00:50:45,430 --> 00:50:42,400

i i

1404

00:50:46,870 --> 00:50:45,440

i want to in my own work contribute

1405

00:50:49,750 --> 00:50:46,880

those kind of perspectives to these

1406

00:50:51,670 --> 00:50:49,760

documents um but i did view that as

1407

00:50:54,390 --> 00:50:51,680

falling into the the broader category

1408

00:50:56,230 --> 00:50:54,400

that britney spoke about last week of uh

1409

00:50:59,109 --> 00:50:56,240

you know how to habitable how do

1410

00:51:01,670 --> 00:50:59,119

habitable worlds form uh so i took it as

1411

00:51:04,069 --> 00:51:01,680

our goal for this presentation to think

1412

00:51:06,230 --> 00:51:04,079

about how planetary exploration informs

1413

00:51:07,670 --> 00:51:06,240

habitability that is what are the

1414

00:51:09,990 --> 00:51:07,680

results that we're getting from cassini

1415

00:51:11,750 --> 00:51:10,000

for example uh telling us about titan's

1416

00:51:14,390 --> 00:51:11,760

interior um

1417

00:51:17,510 --> 00:51:14,400

like how how thick the the ice shell is

1418

00:51:19,750 --> 00:51:17,520

uh you know and how um

1419

00:51:22,390 --> 00:51:19,760

how deep uh the high pressure ice layer

1420

00:51:24,069 --> 00:51:22,400

would be and the example that you cite

1421

00:51:26,150 --> 00:51:24,079

um

1422

00:51:29,670 --> 00:51:26,160

so i i realized we're walking the fine

1423

00:51:31,430 --> 00:51:29,680

line uh and i initially wanted to shy

1424

00:51:32,390 --> 00:51:31,440

away from mentioning specific missions

1425

00:51:34,390 --> 00:51:32,400

at all

1426

00:51:38,230 --> 00:51:34,400

and focus just on things that we can

1427

00:51:40,710 --> 00:51:38,240

learn uh from from planetary exploration

1428

00:51:44,790 --> 00:51:43,109

yeah i think that's okay steve i mean if

1429

00:51:45,589 --> 00:51:44,800

it's in another part of the

1430

00:51:46,790 --> 00:51:45,599

the

1431

00:51:48,309 --> 00:51:46,800

futures

1432

00:51:50,150 --> 00:51:48,319

network or roadmap or whatever we're

1433

00:51:51,670 --> 00:51:50,160

calling i think that's okay i just want

1434

00:51:52,549 --> 00:51:51,680

to make sure that that sort of stuff is

1435

00:51:54,069 --> 00:51:52,559

not

1436

00:51:55,589 --> 00:51:54,079

it needs to be it needs to be part of

1437

00:51:56,790 --> 00:51:55,599

what we're talking about over the next

1438

00:51:57,910 --> 00:51:56,800

decade or two

1439

00:51:59,430 --> 00:51:57,920

and beyond

1440

00:52:02,870 --> 00:51:59,440

john well there's this whole concern

1441

00:52:04,790 --> 00:52:02,880

about whether or not a perched ocean

1442

00:52:06,790 --> 00:52:04,800

can actually support life

1443

00:52:09,190 --> 00:52:06,800

whether or not an original life or just

1444

00:52:10,870 --> 00:52:09,200

continuous and how dirty the ice has to

1445

00:52:13,349 --> 00:52:10,880

be before it becomes

1446

00:52:15,430 --> 00:52:13,359

silicacious enough to be envisioned as a

1447

00:52:17,670 --> 00:52:15,440

habitable environment

1448

00:52:21,270 --> 00:52:17,680

that's an argument that's used about

1449

00:52:22,630 --> 00:52:21,280

ganymede and about callisto as well

1450

00:52:23,750 --> 00:52:22,640

sean it'd be great if you could just

1451
00:52:25,750 --> 00:52:23,760
send us a

1452
00:52:27,430 --> 00:52:25,760
question sort of a comment about you

1453
00:52:29,190 --> 00:52:27,440
know aspects of habitability in the

1454
00:52:31,109 --> 00:52:29,200
solar system that are not necessarily

1455
00:52:32,470 --> 00:52:31,119
connected with missions but you know

1456
00:52:33,990 --> 00:52:32,480
address some of these fundamental

1457
00:52:35,750 --> 00:52:34,000
principles that would be associated with

1458
00:52:37,109 --> 00:52:35,760
our concept of habitability that would

1459
00:52:39,030 --> 00:52:37,119
be great

1460
00:52:40,549 --> 00:52:39,040
you got it i'm steve i might uh take a

1461
00:52:42,230 --> 00:52:40,559
look at your abstraction age before i

1462
00:52:44,069 --> 00:52:42,240
put that in there

1463
00:52:46,150 --> 00:52:44,079

right here is not yet connected to

1464

00:52:48,870 --> 00:52:46,160

mission

1465

00:52:52,069 --> 00:52:48,880

in the last uh few minutes that we we

1466

00:52:54,230 --> 00:52:52,079

have are there any other topics that

1467

00:52:56,870 --> 00:52:54,240

people would like to raise that haven't

1468

00:52:59,670 --> 00:52:56,880

been covered so far or that might be

1469

00:53:00,790 --> 00:52:59,680

helpful for the authoring team to

1470

00:53:15,190 --> 00:53:00,800

thing

1471

00:53:19,589 --> 00:53:17,109

that's the sound of everyone thinking

1472

00:53:21,270 --> 00:53:19,599

deeply

1473

00:53:23,829 --> 00:53:21,280

well there's some interesting activity

1474

00:53:26,710 --> 00:53:23,839

in the chat window so

1475

00:53:28,390 --> 00:53:26,720

and then i think we got to something

1476
00:53:30,630 --> 00:53:28,400
late here that was it was very important

1477
00:53:32,630 --> 00:53:30,640
and that is to not be so tied to mission

1478
00:53:34,309 --> 00:53:32,640
cues but to think in a much more

1479
00:53:35,750 --> 00:53:34,319
fundamental way about be sure that we

1480
00:53:36,549 --> 00:53:35,760
also think in a very fundamental way

1481
00:53:38,870 --> 00:53:36,559
about

1482
00:53:46,390 --> 00:53:38,880
habitability in all of its aspects in

1483
00:53:49,109 --> 00:53:47,430
okay

1484
00:53:52,150 --> 00:53:49,119
if there are

1485
00:53:54,950 --> 00:53:52,160
no other um topics that people want to

1486
00:53:58,710 --> 00:53:54,960
introduce at this point let me encourage

1487
00:54:01,510 --> 00:53:58,720
you to go over to the document uh and to

1488
00:54:03,190 --> 00:54:01,520

make sure that you annotate it uh with

1489

00:54:06,230 --> 00:54:03,200

anywhere that you think you can make a

1490

00:54:08,390 --> 00:54:06,240

useful contribution to that the slides

1491

00:54:10,950 --> 00:54:08,400

are available you'll find that there's a

1492

00:54:13,829 --> 00:54:10,960

link to a google docs set of them

1493

00:54:15,990 --> 00:54:13,839

we haven't made the slides commentable

1494

00:54:17,829 --> 00:54:16,000

uh they're read only

1495

00:54:19,430 --> 00:54:17,839

we could change that if anyone feels

1496

00:54:20,630 --> 00:54:19,440

that it would be useful to comment

1497

00:54:22,309 --> 00:54:20,640

besides but

1498

00:54:24,950 --> 00:54:22,319

at this point we're just trying to limit

1499

00:54:27,750 --> 00:54:24,960

the conversation to the document just to

1500

00:54:29,510 --> 00:54:27,760

make it easy for the authors to have all

1501
00:54:30,790 --> 00:54:29,520
of their thoughts there

1502
00:54:33,349 --> 00:54:30,800
um

1503
00:54:35,030 --> 00:54:33,359
okay just having a look

1504
00:54:37,270 --> 00:54:35,040
right we'll

1505
00:54:40,950 --> 00:54:37,280
we'll leave uh gentlemen trying to

1506
00:54:43,270 --> 00:54:40,960
channel in the text box there um

1507
00:54:44,549 --> 00:54:43,280
thank you very much everyone that was uh

1508
00:54:46,470 --> 00:54:44,559
it was a great and very useful

1509
00:54:49,910 --> 00:54:46,480
conversation and uh thank you to our

1510
00:54:52,470 --> 00:54:49,920
presenters uh the next webinar is

1511
00:54:54,630 --> 00:54:52,480
tomorrow same time whatever your time

1512
00:54:56,710 --> 00:54:54,640
zone might be so thank you very much and