



Andy Burnett

Aaron Goldman

Michael New

Nick Hud

tim morley

Attendees (34)

▼ Hosts (2)

- Estelle Dodson
- Mike Toillion

▼ Presenters (6)

- Aaron Goldman
- Andy Burnett
- Michael New
- Nick Hud
- Presenter
- tim morley

▼ Participants (26)

- Aaron Burton
- Andy Ellington
- Blair
- bruner
- Chris Glein
- Chris House
- Damien Woods
- Eric Smith
- G. Cody
- Jamie Elsila
- Kinnari

Open Chat (Everyone)

Q&A, you may press *6 to unmute if you would like to speak.

Mike Toillion: Please remain muted when not speaking. Thanks!
----- (05/13/2013 10:18) -----

Mike Toillion: Feel free to add any comments or questions here in the chat window.
----- (05/13/2013 10:22) -----

Michael New: Can anyone define "accretor" for me? As opposed to a "replicator"...

Andy Ellington: Here is a chat window.

Andy Ellington: Yup, it works.

Sanjoy: Thanks Michael :)

Andy Ellington: Now this I can deal with; video sux.

Chris House: I agree with Nick, in my option, it would better not to allow the word "replicator" seriously limit what can be proposed for exploration.
----- (05/13/2013 10:25) -----

Michael New: So, a replicator makes more of itself. What does an accretor do?

Andy Ellington: An accretor survives, by accreting function.

Andy Ellington: It is the Swiss Army Knife of origins.

G. Cody is typing...

Live Notes

Prebiotic life Panel.pptx

Full Screen

Opening Panel Questions

- Nucleic acids transfer information in a quantized way, in the sense that mutations can accumulate. Not all replicators do this (i.e., Ghadiri's peptide replicators). How can different types of replicating systems adapt and evolve?
- How is life impacted by elemental boundary conditions? If we had a very different set of metal ions in the environment, how would that impact the functionality of living systems similar to those that have arisen on Earth?
- What roles, if any, could minerals have played as early catalysts?
- If life evolved through a series of biopolymers (e.g., pre-RNA to RNA to DNA/protein), what principles underlie and drive these transitions?

1
00:00:13,509 --> 00:00:10,870
so uh good afternoon good morning

2
00:00:16,870 --> 00:00:13,519
everyone wherever you happen to be um

3
00:00:20,710 --> 00:00:16,880
i'm andy burnett and i am pleased to be

4
00:00:24,630 --> 00:00:20,720
hosting the next in our series of uh

5
00:00:27,509 --> 00:00:24,640
nasa astrobiology road mapping webinars

6
00:00:30,230 --> 00:00:27,519
um and today

7
00:00:32,630 --> 00:00:30,240
the the lineup of presenters is possibly

8
00:00:34,870 --> 00:00:32,640
changing even as we speak but we've

9
00:00:37,750 --> 00:00:34,880
definitely got uh aaron goldman and

10
00:00:40,310 --> 00:00:37,760
we've got andy ellington and i'm hoping

11
00:00:43,270 --> 00:00:40,320
that we may have nick hud and i'm going

12
00:00:47,670 --> 00:00:45,110
just say again eric yeah nick head

13
00:00:49,510 --> 00:00:47,680

signed in now oh there you go you see

14

00:00:51,189 --> 00:00:49,520

even as i said even as we spoke and

15

00:00:53,270 --> 00:00:51,199

there he is i was actually on the phone

16

00:00:55,430 --> 00:00:53,280

i was trying to find that start sharing

17

00:00:57,670 --> 00:00:55,440

button yeah

18

00:00:58,709 --> 00:00:57,680

what on the phone

19

00:00:59,670 --> 00:00:58,719

yeah

20

00:01:01,830 --> 00:00:59,680

um

21

00:01:04,149 --> 00:01:01,840

okay so in that case we have a full

22

00:01:06,950 --> 00:01:04,159

compliment we've also got michael new

23

00:01:09,590 --> 00:01:06,960

from nasa's astro biology group

24

00:01:11,830 --> 00:01:09,600

and my colleague tim morley over on my

25

00:01:13,990 --> 00:01:11,840

right who is going to be monitoring our

26

00:01:16,630 --> 00:01:14,000

chat window and we're going to do a

27

00:01:19,830 --> 00:01:16,640

process uh of sort of shunting your

28

00:01:21,270 --> 00:01:19,840

questions from chat into the live notes

29

00:01:22,870 --> 00:01:21,280

ah there we go make sure you got your

30

00:01:23,910 --> 00:01:22,880

camera working that's great

31

00:01:25,350 --> 00:01:23,920

um

32

00:01:27,990 --> 00:01:25,360

and

33

00:01:29,749 --> 00:01:28,000

the basic process just in case you

34

00:01:31,990 --> 00:01:29,759

weren't here for the first one that we

35

00:01:33,910 --> 00:01:32,000

held last week which by the way is

36

00:01:35,590 --> 00:01:33,920

available on youtube and you can get to

37

00:01:36,630 --> 00:01:35,600

it straight from the front of the

38

00:01:39,190 --> 00:01:36,640

website

39

00:01:40,630 --> 00:01:39,200

basic process is we're

40

00:01:42,710 --> 00:01:40,640

we're going to

41

00:01:44,469 --> 00:01:42,720

uh have an opportunity for the panelists

42

00:01:45,990 --> 00:01:44,479

to talk about some of the questions that

43

00:01:48,469 --> 00:01:46,000

the nasa team

44

00:01:51,030 --> 00:01:48,479

have identified as being particularly

45

00:01:53,030 --> 00:01:51,040

interesting for them in terms of the

46

00:01:54,550 --> 00:01:53,040

development of this road mapping

47

00:01:56,310 --> 00:01:54,560

framework

48

00:01:58,469 --> 00:01:56,320

and then after we've been through that

49

00:02:00,469 --> 00:01:58,479

which might run for 20 minutes half an

50

00:02:05,030 --> 00:02:00,479

hour we're going to throw it open to

51
00:02:07,270 --> 00:02:05,040
everyone who's online with us um for q a

52
00:02:10,350 --> 00:02:07,280
and then just before we wrap up i'm

53
00:02:12,470 --> 00:02:10,360
going to encourage everyone to go to the

54
00:02:14,309 --> 00:02:12,480
astrobiologyfuture.org website where

55
00:02:16,150 --> 00:02:14,319
we've taken a number of the questions

56
00:02:18,309 --> 00:02:16,160
that have been identified more than

57
00:02:20,550 --> 00:02:18,319
we'll be covering in this session and

58
00:02:22,710 --> 00:02:20,560
we've dropped them straight in as

59
00:02:25,350 --> 00:02:22,720
discussion threads and i'll make sure to

60
00:02:26,949 --> 00:02:25,360
show you that before we end up so we'd

61
00:02:29,670 --> 00:02:26,959
very much like to encourage the

62
00:02:32,390 --> 00:02:29,680
conversation because everything that you

63
00:02:33,350 --> 00:02:32,400

discuss prior to the workshop helps to

64

00:02:36,710 --> 00:02:33,360

shape

65

00:02:40,150 --> 00:02:36,720

the the agenda for the workshop

66

00:02:43,350 --> 00:02:40,160

so um with that michael do you want to

67

00:02:46,309 --> 00:02:43,360

set context for a moment on on this

68

00:02:48,630 --> 00:02:46,319

particular work on this webinar

69

00:02:50,869 --> 00:02:48,640

sure absolutely thank you

70

00:02:52,229 --> 00:02:50,879

so i'm michael new i'm the astrobiology

71

00:02:53,990 --> 00:02:52,239

discipline scientist at nasa

72

00:02:55,589 --> 00:02:54,000

headquarters some of you know me

73

00:02:57,270 --> 00:02:55,599

personally some of you only gotten

74

00:02:59,030 --> 00:02:57,280

emails from me and many of you probably

75

00:03:00,869 --> 00:02:59,040

have no idea who i am

76

00:03:03,830 --> 00:03:00,879

um

77

00:03:05,589 --> 00:03:03,840

we at nasa started

78

00:03:08,070 --> 00:03:05,599

communicating with the community about

79

00:03:10,149 --> 00:03:08,080

getting this roadmap workshop going

80

00:03:13,509 --> 00:03:10,159

a little while ago and we're trying to

81

00:03:17,830 --> 00:03:13,519

cast as broad a net as possible in order

82

00:03:20,070 --> 00:03:17,840

to really find the compelling

83

00:03:22,550 --> 00:03:20,080

that will guide astrobiology for the

84

00:03:24,070 --> 00:03:22,560

next decade the astrobiology roadmap is

85

00:03:27,350 --> 00:03:24,080

something we

86

00:03:30,070 --> 00:03:27,360

create once a decade and we update it

87

00:03:32,470 --> 00:03:30,080

once every five years

88

00:03:34,630 --> 00:03:32,480

in order to guide the field as a whole

89

00:03:36,949 --> 00:03:34,640

then when i say that i mean not just

90

00:03:39,350 --> 00:03:36,959

guide what people propose to nasa but

91

00:03:41,270 --> 00:03:39,360

also what um nasa is interested in

92

00:03:43,750 --> 00:03:41,280

funding as well

93

00:03:45,509 --> 00:03:43,760

so we're trying to cast as wide a net as

94

00:03:47,990 --> 00:03:45,519

possible we want

95

00:03:49,990 --> 00:03:48,000

the most uh creative thoughts and

96

00:03:52,470 --> 00:03:50,000

innovation innovative ideas we can get

97

00:03:55,670 --> 00:03:52,480

out of this there's always time later on

98

00:03:56,789 --> 00:03:55,680

to um we know that large list down and

99

00:03:59,110 --> 00:03:56,799

say hey

100

00:04:01,750 --> 00:03:59,120

maybe we can't do this in 10 years or

101

00:04:03,350 --> 00:04:01,760

really that's important not

102

00:04:05,670 --> 00:04:03,360

but in the between there's a lot of

103

00:04:08,550 --> 00:04:05,680

ideas that we want to capture and we

104

00:04:09,509 --> 00:04:08,560

want to use and so this is the start of

105

00:04:11,910 --> 00:04:09,519

the op

106

00:04:14,229 --> 00:04:11,920

this is the start

107

00:04:16,789 --> 00:04:14,239

of looking into these questions for the

108

00:04:19,270 --> 00:04:16,799

particular area of prebiotic chemistry

109

00:04:21,349 --> 00:04:19,280

we define generally prebiotic chemistry

110

00:04:22,950 --> 00:04:21,359

as the chemistry that happens on a

111

00:04:24,870 --> 00:04:22,960

planetary surface so you have to have

112

00:04:26,629 --> 00:04:24,880

planets first

113

00:04:28,710 --> 00:04:26,639

and that leads from

114

00:04:31,590 --> 00:04:28,720

the basic chemistry on a planetary

115

00:04:33,510 --> 00:04:31,600

surface all the way up to the

116

00:04:35,749 --> 00:04:33,520

origin of life

117

00:04:36,950 --> 00:04:35,759

and some of the early chemical evolution

118

00:04:38,310 --> 00:04:36,960

of that life

119

00:04:39,830 --> 00:04:38,320

now we can argue a lot about the

120

00:04:41,909 --> 00:04:39,840

definition of life i don't want to do

121

00:04:43,670 --> 00:04:41,919

that on this telecon

122

00:04:46,310 --> 00:04:43,680

and we can

123

00:04:48,230 --> 00:04:46,320

argue about where we draw the line at

124

00:04:50,070 --> 00:04:48,240

okay this is prebiotic chemistry now we

125

00:04:51,670 --> 00:04:50,080

have life and we're going elsewhere but

126
00:04:53,110 --> 00:04:51,680
for now those are kinds of the

127
00:04:54,950 --> 00:04:53,120
parameters

128
00:04:56,629 --> 00:04:54,960
so we're interested in the earliest

129
00:04:58,070 --> 00:04:56,639
chemical reactions that produce

130
00:04:59,510 --> 00:04:58,080
biomolecules

131
00:05:01,990 --> 00:04:59,520
we're interested in what those

132
00:05:05,029 --> 00:05:02,000
biomolecules were could have been

133
00:05:08,070 --> 00:05:05,039
looking back in time using both geology

134
00:05:09,990 --> 00:05:08,080
and biology we can maybe see some vague

135
00:05:11,830 --> 00:05:10,000
shadowy outlines of what early life was

136
00:05:14,310 --> 00:05:11,840
like and we'd like to explore that we'd

137
00:05:16,710 --> 00:05:14,320
also like to understand the how the

138
00:05:19,189 --> 00:05:16,720

environmental and chemical parameters of

139

00:05:20,790 --> 00:05:19,199

the early earth or elsewhere

140

00:05:23,029 --> 00:05:20,800

could have shaped

141

00:05:24,870 --> 00:05:23,039

what we see now so that's kind of

142

00:05:27,670 --> 00:05:24,880

roughly the playing field

143

00:05:29,430 --> 00:05:27,680

and um nasa is mostly stepping back

144

00:05:33,029 --> 00:05:29,440

we want this to be community-led

145

00:05:35,749 --> 00:05:33,039

community-driven um so i'll be here but

146

00:05:37,350 --> 00:05:35,759

you shouldn't hear much from me

147

00:05:39,029 --> 00:05:37,360

thanks

148

00:05:40,310 --> 00:05:39,039

okay thank you

149

00:05:42,230 --> 00:05:40,320

um

150

00:05:44,629 --> 00:05:42,240

let me just uh build on one point

151
00:05:47,590 --> 00:05:44,639
michael was saying about really wanting

152
00:05:51,189 --> 00:05:47,600
to hear from the whole community you'll

153
00:05:54,310 --> 00:05:51,199
find when we go to uh the web discussion

154
00:05:56,230 --> 00:05:54,320
forum um that there are some headings on

155
00:05:57,029 --> 00:05:56,240
there and we got some feedback from last

156
00:05:59,270 --> 00:05:57,039
week

157
00:06:01,830 --> 00:05:59,280
that uh people felt a little bit

158
00:06:03,270 --> 00:06:01,840
reluctant to start discussions when they

159
00:06:05,270 --> 00:06:03,280
thought that

160
00:06:07,189 --> 00:06:05,280
they were there on their own and

161
00:06:09,270 --> 00:06:07,199
it was this initial

162
00:06:12,870 --> 00:06:09,280
concern about being first person at the

163
00:06:15,110 --> 00:06:12,880

party so we've put in some questions

164

00:06:16,150 --> 00:06:15,120

which uh the panelists had in fact uh

165

00:06:19,270 --> 00:06:16,160

developed

166

00:06:21,189 --> 00:06:19,280

and we just uh we strongly encourage you

167

00:06:23,189 --> 00:06:21,199

to chip in your thoughts because it

168

00:06:25,270 --> 00:06:23,199

really is very important that we hear

169

00:06:27,749 --> 00:06:25,280

from all the different points of view

170

00:06:29,749 --> 00:06:27,759

and we're also looking uh at

171

00:06:32,070 --> 00:06:29,759

sometime this week and we'll send out a

172

00:06:35,350 --> 00:06:32,080

notice about it uh inviting people to

173

00:06:37,430 --> 00:06:35,360

come and have just an online chat based

174

00:06:38,710 --> 00:06:37,440

discussion so using the same adobe

175

00:06:40,629 --> 00:06:38,720

connect pro

176

00:06:42,629 --> 00:06:40,639

but if you find you prefer to bounce

177

00:06:44,230 --> 00:06:42,639

ideas around when there are other people

178

00:06:45,510 --> 00:06:44,240

online then we'll see if we can schedule

179

00:06:48,150 --> 00:06:45,520

that so we're going to try and use as

180

00:06:50,629 --> 00:06:48,160

many different ways as we can and if you

181

00:06:52,230 --> 00:06:50,639

have any technical questions please go

182

00:06:54,230 --> 00:06:52,240

onto the website just fill in a support

183

00:06:55,990 --> 00:06:54,240

ticket and we will get back to you as

184

00:06:59,990 --> 00:06:56,000

soon as possible

185

00:07:02,710 --> 00:07:00,000

so um having said that let me move on to

186

00:07:04,390 --> 00:07:02,720

our panelists and um and just get some

187

00:07:07,270 --> 00:07:04,400

introductions now

188

00:07:09,749 --> 00:07:07,280

i'm hoping that andy is still here even

189

00:07:11,510 --> 00:07:09,759

though he's the camera you are in that

190

00:07:13,749 --> 00:07:11,520

case um

191

00:07:15,510 --> 00:07:13,759

andy tell us just uh for the people who

192

00:07:18,469 --> 00:07:15,520

don't know you who are you where are you

193

00:07:21,189 --> 00:07:18,479

from why are you interested in this

194

00:07:24,230 --> 00:07:21,199

uh okay i'm andy lincoln university of

195

00:07:27,189 --> 00:07:24,240

texas at austin um i've been on the

196

00:07:28,469 --> 00:07:27,199

periphery of the origins community for a

197

00:07:29,589 --> 00:07:28,479

long time just like i've been on the

198

00:07:32,469 --> 00:07:29,599

periphery

199

00:07:34,070 --> 00:07:32,479

of other communities i maintain a great

200

00:07:35,990 --> 00:07:34,080

interest in origins and a healthy

201
00:07:39,510 --> 00:07:36,000
disrespect for most everything that goes

202
00:07:46,309 --> 00:07:41,670
and moving in that case a natural segue

203
00:07:51,029 --> 00:07:48,550
okay hi i'm nick hud

204
00:07:53,830 --> 00:07:51,039
i'm a nucleic acid

205
00:07:56,150 --> 00:07:53,840
biophysical chemist and my lab is is

206
00:07:57,589 --> 00:07:56,160
heavily involved in origin research in

207
00:08:00,150 --> 00:07:57,599
particular

208
00:08:03,430 --> 00:08:00,160
the origin of nucleic acids and

209
00:08:08,869 --> 00:08:06,309
great thank you aaron

210
00:08:11,830 --> 00:08:08,879
i'm aaron goldman i'm a computational

211
00:08:14,629 --> 00:08:11,840
biologist and so i'm interested in

212
00:08:17,670 --> 00:08:14,639
looking for those ancient signatures of

213
00:08:19,350 --> 00:08:17,680

prebiotic and early evolution

214

00:08:20,950 --> 00:08:19,360

brilliant

215

00:08:23,350 --> 00:08:20,960

okay um

216

00:08:27,189 --> 00:08:23,360

what i'm going to do now hopefully this

217

00:08:29,830 --> 00:08:27,199

will advance my slide

218

00:08:30,710 --> 00:08:29,840

just try that one more time there we go

219

00:08:33,029 --> 00:08:30,720

um

220

00:08:35,350 --> 00:08:33,039

i'm not going to read this out but the

221

00:08:36,949 --> 00:08:35,360

the nasa team developed just a short

222

00:08:39,509 --> 00:08:36,959

rubric saying what they meant by

223

00:08:43,029 --> 00:08:39,519

prebiotic evolution you will find that

224

00:08:45,910 --> 00:08:43,039

that's also on the website in the event

225

00:08:47,750 --> 00:08:45,920

itself we've just popped that in there

226

00:08:49,750 --> 00:08:47,760

well what we did prior to this meeting

227

00:08:51,350 --> 00:08:49,760

was we got the panelists together and

228

00:08:53,670 --> 00:08:51,360

asked them to think about what would be

229

00:08:55,990 --> 00:08:53,680

the interesting questions that they

230

00:08:59,750 --> 00:08:56,000

might want to explore because the whole

231

00:09:01,670 --> 00:08:59,760

purpose of the roadmap is to develop our

232

00:09:05,670 --> 00:09:01,680

research questions and the framework to

233

00:09:08,230 --> 00:09:05,680

explore over the next uh next decade so

234

00:09:10,470 --> 00:09:08,240

we then sub sub-selected from that some

235

00:09:12,150 --> 00:09:10,480

questions to talk about now but with the

236

00:09:13,750 --> 00:09:12,160

very explicit advice of the panelists

237

00:09:16,310 --> 00:09:13,760

that these are in no way meant to

238

00:09:17,590 --> 00:09:16,320

constrain their thinking it's just uh to

239

00:09:19,750 --> 00:09:17,600

give us an opportunity to have a

240

00:09:21,910 --> 00:09:19,760

slightly more structured conversation

241

00:09:23,509 --> 00:09:21,920

so i'm going to pop up the questions

242

00:09:24,310 --> 00:09:23,519

here um

243

00:09:25,990 --> 00:09:24,320

and

244

00:09:27,750 --> 00:09:26,000

i'm going to invite the panelists it's

245

00:09:30,310 --> 00:09:27,760

not a case of one by one you give your

246

00:09:34,310 --> 00:09:30,320

formal response it's um

247

00:09:36,070 --> 00:09:34,320

who wants to start first uh

248

00:09:38,070 --> 00:09:36,080

the first one was was one that looked

249

00:09:39,670 --> 00:09:38,080

verbatim from something i

250

00:09:40,710 --> 00:09:39,680

sent so why don't i go ahead and start

251

00:09:43,509 --> 00:09:40,720

off

252

00:09:44,630 --> 00:09:43,519

sounds a perfect segue go right so

253

00:09:46,710 --> 00:09:44,640

one of the issues i have with the

254

00:09:49,190 --> 00:09:46,720

origins community is that we're looking

255

00:09:51,829 --> 00:09:49,200

back into the past at things that are

256

00:09:54,710 --> 00:09:51,839

very very difficult if not impossible

257

00:09:56,710 --> 00:09:54,720

to really apprehend and so i think that

258

00:09:59,509 --> 00:09:56,720

in order to better understand origins

259

00:10:01,670 --> 00:09:59,519

and astrobiology it behooves us to focus

260

00:10:03,990 --> 00:10:01,680

on questions that we can actually answer

261

00:10:06,949 --> 00:10:04,000

experimentally whenever possible and in

262

00:10:09,190 --> 00:10:06,959

this regard i think that that nasa and

263

00:10:11,829 --> 00:10:09,200

is almost a unique community or the

264

00:10:13,910 --> 00:10:11,839

nasa slash astrobiology slash exobiology

265

00:10:15,590 --> 00:10:13,920

slash origins community is almost a

266

00:10:17,829 --> 00:10:15,600

unique community and really trying to

267

00:10:19,430 --> 00:10:17,839

understand fundamental issues regarding

268

00:10:21,350 --> 00:10:19,440

replicators

269

00:10:24,389 --> 00:10:21,360

it's not something that nih does it's

270

00:10:26,550 --> 00:10:24,399

not something that nsf really does

271

00:10:27,509 --> 00:10:26,560

and so i'm very interested in questions

272

00:10:29,190 --> 00:10:27,519

about

273

00:10:30,630 --> 00:10:29,200

what are different types of replication

274

00:10:33,269 --> 00:10:30,640

i actually consider nucleic acid

275

00:10:35,750 --> 00:10:33,279

replicators to be a subset of all

276

00:10:37,269 --> 00:10:35,760

possible replicators and an interesting

277

00:10:39,110 --> 00:10:37,279

subset in that they're one of the only

278

00:10:41,110 --> 00:10:39,120

ones i know that actually can hold and

279

00:10:43,269 --> 00:10:41,120

change information and those are two

280

00:10:44,949 --> 00:10:43,279

very different things so i'd be

281

00:10:47,990 --> 00:10:44,959

interested moving forward in actually

282

00:10:50,150 --> 00:10:48,000

developing a framework for how to

283

00:10:52,069 --> 00:10:50,160

classify replicators how to say

284

00:10:53,910 --> 00:10:52,079

something about their potential for

285

00:10:56,949 --> 00:10:53,920

information carrying and information

286

00:10:58,069 --> 00:10:56,959

transfer and even how such processes of

287

00:11:03,030 --> 00:10:58,079

information

288

00:11:05,269 --> 00:11:03,040

out in terms of larger functionalities

289

00:11:06,630 --> 00:11:05,279

so there's just sort of a rephrasing of

290

00:11:07,350 --> 00:11:06,640

something i already wrote but that was

291

00:11:12,230 --> 00:11:07,360

the

292

00:11:13,509 --> 00:11:12,240

be as forward looking as possible and

293

00:11:15,350 --> 00:11:13,519

not backward looking because i think

294

00:11:22,310 --> 00:11:15,360

backward looking we have hasn't gotten

295

00:11:27,750 --> 00:11:24,790

great so andy just out of curiosity what

296

00:11:30,550 --> 00:11:27,760

what sort of research

297

00:11:32,630 --> 00:11:30,560

questions would come to mind

298

00:11:34,949 --> 00:11:32,640

right so you know again

299

00:11:36,949 --> 00:11:34,959

any of these tend to be

300

00:11:39,030 --> 00:11:36,959

tend to be couched in things i know or

301

00:11:41,509 --> 00:11:39,040

grants that i would write and so with

302

00:11:43,750 --> 00:11:41,519

that i know with that proviso you know

303

00:11:45,670 --> 00:11:43,760

what you know um you know

304

00:11:48,069 --> 00:11:45,680

as you make not as you make modified

305

00:11:50,710 --> 00:11:48,079

genetic alphabets what is the fidelity

306

00:11:51,430 --> 00:11:50,720

of a modified genetic alphabet what are

307

00:11:53,670 --> 00:11:51,440

the

308

00:11:55,910 --> 00:11:53,680

conformational repertoires available to

309

00:11:57,190 --> 00:11:55,920

a modified genetic alphabet to what

310

00:11:59,350 --> 00:11:57,200

extent

311

00:12:01,829 --> 00:11:59,360

is a modified genetic alphabet capable

312

00:12:03,590 --> 00:12:01,839

of mutation you know are there optimal

313

00:12:06,870 --> 00:12:03,600

alphabet sizes what are the parameters

314

00:12:09,829 --> 00:12:06,880

that determine optimal alphabet size how

315

00:12:13,110 --> 00:12:09,839

do sloppy replicators compare to

316

00:12:14,069 --> 00:12:13,120

faithful replicators in terms of

317

00:12:15,829 --> 00:12:14,079

the

318

00:12:18,870 --> 00:12:15,839

where function arises and how function

319

00:12:21,269 --> 00:12:18,880

is transferred or even how function

320

00:12:23,350 --> 00:12:21,279

proceeds across an adaptive landscape so

321

00:12:25,190 --> 00:12:23,360

so these are all questions that for me

322

00:12:27,590 --> 00:12:25,200

i can pause it without saying the word

323

00:12:29,990 --> 00:12:27,600

origins once but that i think were very

324

00:12:32,230 --> 00:12:30,000

relevant when we had a big mixture of

325

00:12:35,030 --> 00:12:32,240

compounds early on

326

00:12:36,790 --> 00:12:35,040

on earth or may run across a big mixture

327

00:12:39,030 --> 00:12:36,800

of compound compounds elsewhere in the

328

00:12:41,910 --> 00:12:39,040

universe

329

00:12:44,790 --> 00:12:41,920

excellent can i add on to uh

330

00:12:47,110 --> 00:12:44,800

right ahead um so another way that i've

331

00:12:48,389 --> 00:12:47,120

heard this put is that

332

00:12:50,470 --> 00:12:48,399

that life

333

00:12:53,030 --> 00:12:50,480

stores information

334

00:12:55,350 --> 00:12:53,040

genetic information in a digital way

335

00:12:57,190 --> 00:12:55,360

uh whereas often um

336

00:12:59,269 --> 00:12:57,200

the replicators that we create and and

337

00:13:01,110 --> 00:12:59,279

other uh forms of information in life

338

00:13:04,389 --> 00:13:01,120

are analog and so

339

00:13:08,310 --> 00:13:04,399

um i think that within this question it

340

00:13:09,110 --> 00:13:08,320

would also be interesting um to study

341

00:13:11,350 --> 00:13:09,120

how

342

00:13:13,590 --> 00:13:11,360

one kind of replicator can turn into

343

00:13:14,710 --> 00:13:13,600

another kind of replicator that might

344

00:13:16,550 --> 00:13:14,720

have more

345

00:13:19,750 --> 00:13:16,560

uh potential to be

346

00:13:23,269 --> 00:13:21,910

sure i mean i think that i think it you

347

00:13:25,350 --> 00:13:23,279

know they're going to see that there's a

348

00:13:27,590 --> 00:13:25,360

continuum of different types of

349

00:13:29,030 --> 00:13:27,600

replicators for me it's not an analog

350

00:13:29,990 --> 00:13:29,040

digital continuum it's more along the

351
00:13:32,550 --> 00:13:30,000
lines of

352
00:13:34,310 --> 00:13:32,560
fidelity of information transfer

353
00:13:35,509 --> 00:13:34,320
and you know conformational space

354
00:13:37,910 --> 00:13:35,519
available to you i have more of a

355
00:13:40,389 --> 00:13:37,920
chemist perspective on this but i think

356
00:13:41,990 --> 00:13:40,399
that absolutely we're going to segue you

357
00:13:43,509 --> 00:13:42,000
know we can segue one to the other how

358
00:13:45,670 --> 00:13:43,519
those segways occur when those segways

359
00:13:47,430 --> 00:13:45,680
occur what are the advantages of such a

360
00:13:49,990 --> 00:13:47,440
segway are are really interesting

361
00:13:56,230 --> 00:13:52,710
nick do you want to chip in

362
00:13:59,590 --> 00:13:56,240
yeah so andy i agree with a lot of you

363
00:14:01,590 --> 00:13:59,600

i'm actually wondering though um

364

00:14:03,509 --> 00:14:01,600

whether in this question and it seems

365

00:14:05,030 --> 00:14:03,519

like we have just a few of them whether

366

00:14:05,910 --> 00:14:05,040

it should be broadened or the language

367

00:14:07,829 --> 00:14:05,920

should be

368

00:14:09,670 --> 00:14:07,839

looked at carefully about you know

369

00:14:12,790 --> 00:14:09,680

replicators you know one

370

00:14:15,350 --> 00:14:12,800

new that i have a lot in in the origins

371

00:14:18,710 --> 00:14:15,360

community has been this focus on a

372

00:14:19,829 --> 00:14:18,720

replicator for the replicator uh

373

00:14:21,030 --> 00:14:19,839

you know just for the sake of a

374

00:14:22,389 --> 00:14:21,040

replicator

375

00:14:23,910 --> 00:14:22,399

and um

376

00:14:26,470 --> 00:14:23,920

and i i've had a problem with that

377

00:14:28,710 --> 00:14:26,480

because you know if that thing's gonna

378

00:14:31,910 --> 00:14:28,720

evolve i don't see where you can go and

379

00:14:33,030 --> 00:14:31,920

get other functions that would be

380

00:14:34,230 --> 00:14:33,040

allowed

381

00:14:36,470 --> 00:14:34,240

and so

382

00:14:38,710 --> 00:14:36,480

you know i've i thought that

383

00:14:40,389 --> 00:14:38,720

you know in addition to thinking about

384

00:14:43,670 --> 00:14:40,399

you know what has been classically

385

00:14:46,069 --> 00:14:43,680

discussed as replicators

386

00:14:48,310 --> 00:14:46,079

again going to the broadening of the the

387

00:14:50,790 --> 00:14:48,320

um chemistry that could give you that

388

00:14:52,790 --> 00:14:50,800

you know you could have say

389

00:14:55,430 --> 00:14:52,800

you know assemblies that

390

00:14:57,350 --> 00:14:55,440

you know stabilize

391

00:14:59,350 --> 00:14:57,360

that are similar to themselves so they

392

00:15:01,590 --> 00:14:59,360

last longer or something like that right

393

00:15:03,750 --> 00:15:01,600

and and the process by which they're

394

00:15:06,150 --> 00:15:03,760

produced are not necessarily driven by

395

00:15:07,910 --> 00:15:06,160

that quote-unquote replicator

396

00:15:11,189 --> 00:15:07,920

but you get to build up

397

00:15:13,189 --> 00:15:11,199

of some molecules some polymer that

398

00:15:15,110 --> 00:15:13,199

becomes a species and it gets selected

399

00:15:15,910 --> 00:15:15,120

because it has some type of an activity

400

00:15:19,430 --> 00:15:15,920

right

401
00:15:20,870 --> 00:15:19,440
argument this is a discussion you and i

402
00:15:22,389 --> 00:15:20,880
had over the years about replicators

403
00:15:25,030 --> 00:15:22,399
versus the creators

404
00:15:27,430 --> 00:15:25,040
and i i think the creators are cool

405
00:15:30,230 --> 00:15:27,440
um i've never quite

406
00:15:31,829 --> 00:15:30,240
come up with a theoretical framework for

407
00:15:34,069 --> 00:15:31,839
and a creator not that it necessarily

408
00:15:35,509 --> 00:15:34,079
needs one but one one way one thing i

409
00:15:36,870 --> 00:15:35,519
think we have to gonna have to do going

410
00:15:39,030 --> 00:15:36,880
forward is you know how do we bound

411
00:15:41,350 --> 00:15:39,040
these problems in ways that

412
00:15:43,670 --> 00:15:41,360
um you know the community can can

413
00:15:45,030 --> 00:15:43,680

understand or we can just understand we

414

00:15:46,230 --> 00:15:45,040

know what we're trying to achieve or

415

00:15:47,269 --> 00:15:46,240

even more to the point you know when we

416

00:15:48,470 --> 00:15:47,279

go out to

417

00:15:50,790 --> 00:15:48,480

you know

418

00:15:52,949 --> 00:15:50,800

say the mission of nasa is x to the

419

00:15:54,470 --> 00:15:52,959

public you know we can i think with some

420

00:15:55,829 --> 00:15:54,480

reasonable confidence say you know by

421

00:15:57,670 --> 00:15:55,839

god we're going to figure out what a

422

00:16:00,150 --> 00:15:57,680

replicator is and we'll find one on

423

00:16:01,350 --> 00:16:00,160

another planet and a crater is such a

424

00:16:03,110 --> 00:16:01,360

cool

425

00:16:04,550 --> 00:16:03,120

idea it it

426

00:16:06,870 --> 00:16:04,560

it it's

427

00:16:09,590 --> 00:16:06,880

again it's a neat thing but i but i've

428

00:16:11,829 --> 00:16:09,600

never really figured out how to do good

429

00:16:13,430 --> 00:16:11,839

accreter research i mean the best i the

430

00:16:15,189 --> 00:16:13,440

best like i can see is there there's

431

00:16:17,189 --> 00:16:15,199

there's hints of a creator

432

00:16:18,790 --> 00:16:17,199

research occurring in the dna nanotech

433

00:16:21,269 --> 00:16:18,800

field and other of the fields that i

434

00:16:22,870 --> 00:16:21,279

hang on the edge of and you're beginning

435

00:16:24,470 --> 00:16:22,880

to see some of these issues that you

436

00:16:28,389 --> 00:16:24,480

just raised actually answered

437

00:16:29,509 --> 00:16:28,399

experimentally sort of in that field but

438

00:16:31,509 --> 00:16:29,519

i don't know if those answers are

439

00:16:33,590 --> 00:16:31,519
satisfactory for us or for you i i

440

00:16:35,990 --> 00:16:33,600
really don't

441

00:16:38,310 --> 00:16:36,000
isn't it

442

00:16:39,829 --> 00:16:38,320
i'm the perennial optimist that i think

443

00:16:41,509 --> 00:16:39,839
that you know we will develop

444

00:16:42,870 --> 00:16:41,519
experimental systems and i you know just

445

00:16:45,030 --> 00:16:42,880
to throw it out to everybody else that's

446

00:16:47,509 --> 00:16:45,040
listening you know what are say just one

447

00:16:49,829 --> 00:16:47,519
example that i could think of that would

448

00:16:52,550 --> 00:16:49,839
match this so that we can you know put

449

00:16:54,470 --> 00:16:52,560
this you know a system to the uh you

450

00:16:58,389 --> 00:16:54,480
know charmic creator you know for

451

00:17:00,949 --> 00:16:58,399

example let's say that we have a pool

452

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

and a chemistry that allows the

453

00:17:06,470 --> 00:17:04,559

spontaneous formation of short peptides

454

00:17:07,990 --> 00:17:06,480

and then there's also some type of

455

00:17:10,390 --> 00:17:08,000

backward reaction right that's

456

00:17:12,069 --> 00:17:10,400

hydrolyzing them and what the creator

457

00:17:13,029 --> 00:17:12,079

might be is

458

00:17:19,590 --> 00:17:13,039

that

459

00:17:21,750 --> 00:17:19,600

themselves from hydrolysis build up

460

00:17:23,750 --> 00:17:21,760

right and so you know if you write out

461

00:17:26,549 --> 00:17:23,760

the equation it's very much akin to a

462

00:17:28,309 --> 00:17:26,559

replicator right thing it's it's you

463

00:17:30,390 --> 00:17:28,319

know templating but it's it's grabbing

464

00:17:32,070 --> 00:17:30,400

on stuff that's made and i bring that up

465

00:17:34,230 --> 00:17:32,080

because

466

00:17:36,470 --> 00:17:34,240

in the language of this i'd be a little

467

00:17:37,909 --> 00:17:36,480

afraid that if it was directed toward

468

00:17:40,230 --> 00:17:37,919

replicator we're going to get everybody

469

00:17:42,710 --> 00:17:40,240

trying to get their hyper cycle and

470

00:17:45,830 --> 00:17:42,720

replication for replication's sake not

471

00:17:49,510 --> 00:17:45,840

necessarily again this buildup of

472

00:17:51,029 --> 00:17:49,520

functional polymers being selected right

473

00:17:54,310 --> 00:17:51,039

at the same time that they're being

474

00:17:56,950 --> 00:17:55,590

yep i mean

475

00:17:58,950 --> 00:17:56,960

again i just think that the thing we

476

00:18:00,470 --> 00:17:58,960

want to not do though is try and be

477

00:18:04,150 --> 00:18:00,480

sitting there juggling

478

00:18:05,590 --> 00:18:04,160

52 grants with 52 different schemas for

479

00:18:06,710 --> 00:18:05,600

a creators where we don't have a way to

480

00:18:08,789 --> 00:18:06,720

compare them the nice thing about

481

00:18:10,870 --> 00:18:08,799

replicators when we at least

482

00:18:12,310 --> 00:18:10,880

you know push on the word information a

483

00:18:14,310 --> 00:18:12,320

little bit or push on the word

484

00:18:16,230 --> 00:18:14,320

confirmation or function because we sort

485

00:18:17,750 --> 00:18:16,240

of at least have a framework to think

486

00:18:19,510 --> 00:18:17,760

about and even if somebody comes forward

487

00:18:20,789 --> 00:18:19,520

with something really weird we can at

488

00:18:22,230 --> 00:18:20,799

least say okay well how would this

489

00:18:25,750 --> 00:18:22,240

compare to

490

00:18:27,110 --> 00:18:25,760

protein it doesn't have to be a dna it

491

00:18:28,390 --> 00:18:27,120

doesn't have to be a protein but at

492

00:18:30,549 --> 00:18:28,400

least we have a an intellectual

493

00:18:32,230 --> 00:18:30,559

framework for for the comparison for an

494

00:18:34,310 --> 00:18:32,240

accreter where we have about zero

495

00:18:37,110 --> 00:18:34,320

examples i'm just worried people will

496

00:18:39,350 --> 00:18:37,120

come in with whack job ideas that

497

00:18:41,190 --> 00:18:39,360

you know may be interesting but don't

498

00:18:42,950 --> 00:18:41,200

really help advance at least what i

499

00:18:44,789 --> 00:18:42,960

think of as the field

500

00:18:45,990 --> 00:18:44,799

they don't provide us with something

501
00:18:47,990 --> 00:18:46,000
that's really going to give us a better

502
00:18:50,870 --> 00:18:48,000
understanding of having a creator could

503
00:18:52,630 --> 00:18:50,880
have functioned at origins or could

504
00:18:56,390 --> 00:18:52,640
you know operate currently in

505
00:18:59,190 --> 00:18:56,400
astrobiology um in another venue

506
00:19:01,430 --> 00:18:59,200
aaron did you yeah

507
00:19:04,230 --> 00:19:01,440
yeah uh and this is this sort of gets

508
00:19:06,390 --> 00:19:04,240
back into my transition point that maybe

509
00:19:08,870 --> 00:19:06,400
the metric we're looking for is whether

510
00:19:10,549 --> 00:19:08,880
it can if there isn't if there's a if

511
00:19:12,789 --> 00:19:10,559
there's a

512
00:19:14,630 --> 00:19:12,799
scheme in which an accreter

513
00:19:17,110 --> 00:19:14,640

could um

514

00:19:18,710 --> 00:19:17,120

continuously evolve into something that

515

00:19:19,830 --> 00:19:18,720

we would recognize more as a genetic

516

00:19:23,029 --> 00:19:19,840

system

517

00:19:24,710 --> 00:19:23,039

um that maybe that's the metric by which

518

00:19:25,510 --> 00:19:24,720

we can

519

00:19:26,549 --> 00:19:25,520

uh

520

00:19:27,669 --> 00:19:26,559

weigh

521

00:19:31,029 --> 00:19:27,679

one

522

00:19:31,990 --> 00:19:31,039

proposal versus another is its ability

523

00:19:33,029 --> 00:19:32,000

to

524

00:19:34,950 --> 00:19:33,039

evolve

525

00:19:37,270 --> 00:19:34,960

um toward a more complex system like the

526

00:19:38,710 --> 00:19:37,280

one that we see

527

00:19:40,230 --> 00:19:38,720

and that actually kind of gets to the

528

00:19:42,630 --> 00:19:40,240

last question so they're starting to

529

00:19:44,950 --> 00:19:42,640

overlap a little bit

530

00:19:47,909 --> 00:19:44,960

well let me pick up just at that moment

531

00:19:50,830 --> 00:19:47,919

and just uh talk to the participants who

532

00:19:54,390 --> 00:19:50,840

are dialed in on here um

533

00:19:56,789 --> 00:19:54,400

we strongly encourage you to add your

534

00:19:59,190 --> 00:19:56,799

thoughts into the chat window just to

535

00:20:01,270 --> 00:19:59,200

make sure it's clear for everyone to the

536

00:20:03,270 --> 00:20:01,280

right hand side of the list of attendees

537

00:20:05,110 --> 00:20:03,280

you'll see a window that's called open

538

00:20:07,510 --> 00:20:05,120

chat

539

00:20:08,789 --> 00:20:07,520

if you want to uh thank you very much

540

00:20:10,950 --> 00:20:08,799

andy um

541

00:20:14,710 --> 00:20:10,960

if you want to uh

542

00:20:16,630 --> 00:20:14,720

add questions comments disagree put in

543

00:20:19,110 --> 00:20:16,640

tangential items that you think we

544

00:20:20,950 --> 00:20:19,120

should be exploring do please do that

545

00:20:23,510 --> 00:20:20,960

great thank you senator

546

00:20:25,750 --> 00:20:23,520

okay um let's move on to our next

547

00:20:28,390 --> 00:20:25,760

question aaron do you want to start

548

00:20:30,549 --> 00:20:28,400

boundary conditions

549

00:20:32,470 --> 00:20:30,559

well i'm actually probably one of the

550

00:20:34,710 --> 00:20:32,480

worst people to start on that one

551
00:20:37,510 --> 00:20:34,720
because uh i think that came from

552
00:20:39,430 --> 00:20:37,520
i'll just sell that next to it yeah

553
00:20:41,190 --> 00:20:39,440
yeah that one looks like it evolved from

554
00:20:43,669 --> 00:20:41,200
mine so just to uh

555
00:20:46,070 --> 00:20:43,679
read that is how is life impacted by

556
00:20:48,230 --> 00:20:46,080
elemental boundary conditions

557
00:20:50,070 --> 00:20:48,240
if we had a very different set of metal

558
00:20:51,510 --> 00:20:50,080
ions in the environment how would that

559
00:20:53,669 --> 00:20:51,520
impact the functionality of living

560
00:20:56,230 --> 00:20:53,679
systems similar to those that have

561
00:20:57,669 --> 00:20:56,240
arisen on earth so

562
00:21:00,149 --> 00:20:57,679
um

563
00:21:02,230 --> 00:21:00,159

in the background of this before

564

00:21:03,990 --> 00:21:02,240

we had sent in a number of questions and

565

00:21:06,149 --> 00:21:04,000

i think that this one

566

00:21:08,390 --> 00:21:06,159

is probably a

567

00:21:10,710 --> 00:21:08,400

you know a summation or came out of a

568

00:21:11,750 --> 00:21:10,720

couple of different ones i had in there

569

00:21:13,350 --> 00:21:11,760

and uh

570

00:21:14,789 --> 00:21:13,360

i i think that

571

00:21:16,870 --> 00:21:14,799

you know the

572

00:21:19,350 --> 00:21:16,880

the it's nice that the first part of

573

00:21:20,470 --> 00:21:19,360

that has to do with the metal ions

574

00:21:21,590 --> 00:21:20,480

because

575

00:21:23,909 --> 00:21:21,600

one

576

00:21:25,669 --> 00:21:23,919

big point i think that we have to

577

00:21:29,270 --> 00:21:25,679

contend with in in original life

578

00:21:32,390 --> 00:21:29,280

scenarios is that the cl that the

579

00:21:34,149 --> 00:21:32,400

uh earlier clearly had a lot more iron

580

00:21:35,750 --> 00:21:34,159

iron ii available right it's all been

581

00:21:38,630 --> 00:21:35,760

precipitated in this banded iron

582

00:21:39,909 --> 00:21:38,640

formation and if you were to point to

583

00:21:43,430 --> 00:21:39,919

um

584

00:21:45,270 --> 00:21:43,440

one metal that would affect chemistry

585

00:21:46,950 --> 00:21:45,280

iron's a good one i mean it's it's an

586

00:21:48,870 --> 00:21:46,960

amazing uh

587

00:21:51,590 --> 00:21:48,880

participant in redox reaction we use it

588

00:21:53,669 --> 00:21:51,600

all the time in life today so it it begs

589

00:21:55,909 --> 00:21:53,679

the question of you know if we're doing

590

00:21:58,470 --> 00:21:55,919

prebiotic chemistry research how you

591

00:21:59,990 --> 00:21:58,480

know how different would that be in an

592

00:22:02,149 --> 00:22:00,000

oxygen free

593

00:22:03,350 --> 00:22:02,159

iron ii rich environment compared to

594

00:22:05,909 --> 00:22:03,360

what we're doing

595

00:22:07,350 --> 00:22:05,919

uh in the lab so i think that we have to

596

00:22:09,669 --> 00:22:07,360

ask those questions i don't think

597

00:22:10,630 --> 00:22:09,679

they've been asked enough and expanding

598

00:22:13,190 --> 00:22:10,640

that too

599

00:22:14,149 --> 00:22:13,200

beyond just the iron

600

00:22:15,909 --> 00:22:14,159

uh

601
00:22:17,669 --> 00:22:15,919
question you know we can think about

602
00:22:19,430 --> 00:22:17,679
again different scenarios having to do

603
00:22:21,110 --> 00:22:19,440
with with the atmosphere was it really

604
00:22:23,909 --> 00:22:21,120
high co2 how does that affect the

605
00:22:25,430 --> 00:22:23,919
atmosphere was it reducing do we have h2

606
00:22:26,549 --> 00:22:25,440
available

607
00:22:28,230 --> 00:22:26,559
i think we've got to think about all

608
00:22:30,710 --> 00:22:28,240
those parameters

609
00:22:32,310 --> 00:22:30,720
and not just give card bonus that you

610
00:22:34,310 --> 00:22:32,320
can do anything you want but it's got to

611
00:22:36,470 --> 00:22:34,320
be connected to a scenario that shows

612
00:22:38,950 --> 00:22:36,480
that this provides interesting chemistry

613
00:22:40,630 --> 00:22:38,960

or interesting ways out of a present

614

00:22:43,750 --> 00:22:40,640

quandary if we consider alternative

615

00:22:50,230 --> 00:22:46,230

if you were going to spend research

616

00:22:50,870 --> 00:22:50,240

money on on this question what what sort

617

00:22:52,470 --> 00:22:50,880

of

618

00:22:54,870 --> 00:22:52,480

research

619

00:22:59,510 --> 00:22:54,880

programs would you be interested in

620

00:22:59,520 --> 00:23:03,029

so um

621

00:23:05,990 --> 00:23:05,190

this is an interesting question and and

622

00:23:09,510 --> 00:23:06,000

all

623

00:23:10,870 --> 00:23:09,520

it with just the same way that andy said

624

00:23:12,470 --> 00:23:10,880

uh when you look at this you're looking

625

00:23:13,590 --> 00:23:12,480

for your own research right and so

626
00:23:15,190 --> 00:23:13,600
you're saying hi you know this is what

627
00:23:17,750 --> 00:23:15,200
i'm doing and i like this you know and

628
00:23:18,870 --> 00:23:17,760
uh and so you know preface it that way

629
00:23:21,590 --> 00:23:18,880
you know one thing that we're doing

630
00:23:22,950 --> 00:23:21,600
right now is we're looking at uh in in

631
00:23:25,029 --> 00:23:22,960
collaboration with my colleague lauren

632
00:23:27,590 --> 00:23:25,039
williams we're looking at what can rna

633
00:23:29,750 --> 00:23:27,600
do when it has iron bound to it rather

634
00:23:31,029 --> 00:23:29,760
than magnesium and the answer is it can

635
00:23:32,789 --> 00:23:31,039
actually do a lot of chemistry it can't

636
00:23:33,990 --> 00:23:32,799
do besides before that

637
00:23:36,549 --> 00:23:34,000
and so that means that we could

638
00:23:38,950 --> 00:23:36,559

potentially solve a lot of problems that

639

00:23:42,149 --> 00:23:38,960

you know now are solved by proteins

640

00:23:44,549 --> 00:23:42,159

you know with rna binding iron

641

00:23:47,029 --> 00:23:44,559

so so looking at you know these kind of

642

00:23:48,710 --> 00:23:47,039

what if questions of what if the system

643

00:23:51,510 --> 00:23:48,720

we had today

644

00:23:54,470 --> 00:23:51,520

was in that alternate environment what

645

00:23:56,470 --> 00:23:54,480

could it do or could it not do right and

646

00:23:58,710 --> 00:23:56,480

so that's to me and i think that that

647

00:24:00,870 --> 00:23:58,720

connects somewhat nicely with what andy

648

00:24:02,710 --> 00:24:00,880

had mentioned andy says you know what is

649

00:24:04,630 --> 00:24:02,720

the you know experimental system that we

650

00:24:05,590 --> 00:24:04,640

can use we don't know

651
00:24:07,430 --> 00:24:05,600
um

652
00:24:09,029 --> 00:24:07,440
everything well we about what the

653
00:24:10,950 --> 00:24:09,039
environment was like or what molecules

654
00:24:13,190 --> 00:24:10,960
were like but we can we can take things

655
00:24:14,630 --> 00:24:13,200
we have to extrapolate back

656
00:24:15,990 --> 00:24:14,640
and i think that

657
00:24:18,549 --> 00:24:16,000
you know those are really good questions

658
00:24:19,830 --> 00:24:18,559
to ask you know with the biopolymers we

659
00:24:21,830 --> 00:24:19,840
have today

660
00:24:23,029 --> 00:24:21,840
under the alternative condition you know

661
00:24:25,510 --> 00:24:23,039
maybe

662
00:24:28,070 --> 00:24:25,520
you know um the

663
00:24:30,230 --> 00:24:28,080

minerals the solvents the ions the

664

00:24:32,630 --> 00:24:30,240

atmosphere all all different

665

00:24:36,549 --> 00:24:32,640

and so that that could uh

666

00:24:37,590 --> 00:24:36,559

give us um some insights on how they

667

00:24:39,430 --> 00:24:37,600

might have been able to function

668

00:24:41,750 --> 00:24:39,440

differently constraints on whether they

669

00:24:43,430 --> 00:24:41,760

really did start at those times um

670

00:24:44,789 --> 00:24:43,440

constraints on what the environment must

671

00:24:47,510 --> 00:24:44,799

have been at the time that they did

672

00:24:49,590 --> 00:24:47,520

emerge

673

00:24:52,149 --> 00:24:49,600

possibly

674

00:24:54,149 --> 00:24:52,159

broader broader than uh

675

00:24:55,830 --> 00:24:54,159

this question would be

676
00:24:58,390 --> 00:24:55,840
which aspects of biology and

677
00:25:01,029 --> 00:24:58,400
biochemistry

678
00:25:03,029 --> 00:25:01,039
are not only bound elemental boundary

679
00:25:04,789 --> 00:25:03,039
are are uh impacted by the elemental

680
00:25:06,789 --> 00:25:04,799
boundary conditions but also just the

681
00:25:08,789 --> 00:25:06,799
historical contingencies

682
00:25:11,269 --> 00:25:08,799
of life's origins so

683
00:25:13,669 --> 00:25:11,279
um for example the main energy currency

684
00:25:17,590 --> 00:25:13,679
of life is also

685
00:25:18,630 --> 00:25:17,600
the main subunit of the genetic molecule

686
00:25:21,029 --> 00:25:18,640
and

687
00:25:22,390 --> 00:25:21,039
is that because those two that molecule

688
00:25:24,630 --> 00:25:22,400

is really good at both or is that

689

00:25:25,750 --> 00:25:24,640

because they can do both and

690

00:25:27,990 --> 00:25:25,760

um

691

00:25:34,149 --> 00:25:28,000

and the origin of life just so happened

692

00:25:37,990 --> 00:25:36,470

andy do you want to add anything on this

693

00:25:39,830 --> 00:25:38,000

yeah so i have a i think a slightly

694

00:25:41,269 --> 00:25:39,840

different view than the nick or perhaps

695

00:25:42,870 --> 00:25:41,279

some of the other participants i'm not

696

00:25:44,789 --> 00:25:42,880

particularly concerned

697

00:25:46,230 --> 00:25:44,799

about the boundary conditions for earth

698

00:25:48,070 --> 00:25:46,240

i'm really again

699

00:25:50,070 --> 00:25:48,080

much more interested in in novel

700

00:25:51,350 --> 00:25:50,080

chemistry how do chemistries different

701
00:25:53,990 --> 00:25:51,360
chemistries

702
00:25:55,590 --> 00:25:54,000
promote the

703
00:25:57,590 --> 00:25:55,600
the origin and evolution of any of a

704
00:25:59,190 --> 00:25:57,600
variety of of living systems and for

705
00:26:01,510 --> 00:25:59,200
living systems i generally confine

706
00:26:03,669 --> 00:26:01,520
myself to to replicators rather than

707
00:26:05,990 --> 00:26:03,679
creators but we can make it broader as

708
00:26:07,750 --> 00:26:06,000
necessary so the problem is of course as

709
00:26:09,269 --> 00:26:07,760
and i think nick did point this out that

710
00:26:10,789 --> 00:26:09,279
we don't have a whole heck of a lot of

711
00:26:13,190 --> 00:26:10,799
examples but what i could see being

712
00:26:16,310 --> 00:26:13,200
funded out of this would be anything

713
00:26:18,310 --> 00:26:16,320

from say lee cronin's molybdenum

714

00:26:20,710 --> 00:26:18,320

replicators that he's been

715

00:26:23,430 --> 00:26:20,720

mucking about with over in glasgow

716

00:26:27,190 --> 00:26:23,440

up through folks who wanted to expand

717

00:26:28,630 --> 00:26:27,200

the genetic code to 256 amino acids and

718

00:26:32,149 --> 00:26:28,640

while the latter

719

00:26:35,190 --> 00:26:32,159

is definitively post origins nonetheless

720

00:26:37,430 --> 00:26:35,200

it is a system that allows us to explore

721

00:26:40,149 --> 00:26:37,440

what chemistries help or don't help if

722

00:26:42,630 --> 00:26:40,159

you know we had more selenium um in the

723

00:26:44,950 --> 00:26:42,640

environment what redox chemistries would

724

00:26:46,950 --> 00:26:44,960

cells evolve could they evolve you know

725

00:26:49,269 --> 00:26:46,960

if we remove potassium from the

726

00:26:51,269 --> 00:26:49,279

environment so that we can go on very

727

00:26:52,390 --> 00:26:51,279

long space journeys without k-40 eating

728

00:26:54,630 --> 00:26:52,400

this up

729

00:26:56,789 --> 00:26:54,640

you know what would those

730

00:26:57,909 --> 00:26:56,799

cells be like so i think that cells give

731

00:26:59,190 --> 00:26:57,919

us a nice

732

00:27:00,950 --> 00:26:59,200

a nice

733

00:27:02,710 --> 00:27:00,960

system for exploring changes in

734

00:27:04,149 --> 00:27:02,720

chemistry that affects living systems

735

00:27:05,190 --> 00:27:04,159

and other than that we're going to have

736

00:27:07,110 --> 00:27:05,200

to

737

00:27:08,950 --> 00:27:07,120

either again change you know genetic

738

00:27:09,990 --> 00:27:08,960

alphabets or other sort of replicator

739

00:27:12,549 --> 00:27:10,000

based

740

00:27:15,269 --> 00:27:12,559

chemistries or come up with really

741

00:27:16,470 --> 00:27:15,279

cool new chemistry you know again

742

00:27:18,549 --> 00:27:16,480

or other

743

00:27:21,750 --> 00:27:18,559

replicators that that

744

00:27:24,230 --> 00:27:21,760

almost defy description at this point

745

00:27:25,669 --> 00:27:24,240

so let me um come in there and and kind

746

00:27:27,909 --> 00:27:25,679

of

747

00:27:29,830 --> 00:27:27,919

perhaps disagree a bit with andy there

748

00:27:31,110 --> 00:27:29,840

is that within the

749

00:27:34,630 --> 00:27:31,120

um

750

00:27:37,430 --> 00:27:34,640

charge of you know the the uh program on

751
00:27:41,029 --> 00:27:37,440
prebiotic evolution i you know i'm i'm

752
00:27:42,789 --> 00:27:41,039
not i'm not so sure that you want to

753
00:27:45,110 --> 00:27:42,799
just open it up to you know what

754
00:27:46,789 --> 00:27:45,120
replicator of anything right because i

755
00:27:50,470 --> 00:27:46,799
think that the ultimate goal of this is

756
00:27:52,950 --> 00:27:50,480
to see um you know how life on earth

757
00:27:54,470 --> 00:27:52,960
could get going or got going and you

758
00:27:56,549 --> 00:27:54,480
know can we have

759
00:27:58,470 --> 00:27:56,559
similar life on other places i mean if

760
00:28:00,789 --> 00:27:58,480
you broaden it up like you say

761
00:28:02,950 --> 00:28:00,799
you say that is lee's cronin system

762
00:28:06,070 --> 00:28:02,960
living or not the problem is that the

763
00:28:08,630 --> 00:28:06,080

space is so broad in chemistry our

764

00:28:10,149 --> 00:28:08,640

chemistry space rather is so broad that

765

00:28:12,230 --> 00:28:10,159

i think then you know then we get into

766

00:28:13,990 --> 00:28:12,240

this well is this living or is it not i

767

00:28:16,870 --> 00:28:14,000

think we're better off

768

00:28:18,870 --> 00:28:16,880

if we are looking at systems that are

769

00:28:21,029 --> 00:28:18,880

you know connected to what we had today

770

00:28:21,990 --> 00:28:21,039

or we think our potential ancestors that

771

00:28:24,710 --> 00:28:22,000

we had

772

00:28:26,389 --> 00:28:24,720

and then asking the question how could

773

00:28:28,630 --> 00:28:26,399

the environment

774

00:28:31,029 --> 00:28:28,640

have facilitated this

775

00:28:34,630 --> 00:28:31,039

um on the early earth

776

00:28:36,310 --> 00:28:34,640

or how could your favorite scenario you

777

00:28:38,630 --> 00:28:36,320

know would have it been allowed or

778

00:28:41,350 --> 00:28:38,640

disallowed by what we know now the

779

00:28:43,590 --> 00:28:41,360

constraints are you know still being

780

00:28:45,510 --> 00:28:43,600

formulated for the early earth and you

781

00:28:48,149 --> 00:28:45,520

know george cody had put into the chat

782

00:28:50,710 --> 00:28:48,159

box there you know something about

783

00:28:52,789 --> 00:28:50,720

uh geochemical constraints and an

784

00:28:54,389 --> 00:28:52,799

elemental availability and you know as

785

00:28:57,110 --> 00:28:54,399

he said like phosphorus is still a

786

00:28:59,830 --> 00:28:57,120

problem right or it's a is a problem in

787

00:29:02,789 --> 00:28:59,840

the absence of life you know so

788

00:29:05,750 --> 00:29:02,799

these i think are are big questions

789

00:29:07,350 --> 00:29:05,760

um that are already broad enough without

790

00:29:09,669 --> 00:29:07,360

saying you know we'll let life be

791

00:29:10,870 --> 00:29:09,679

whatever you want to define us

792

00:29:13,110 --> 00:29:10,880

yeah so

793

00:29:14,950 --> 00:29:13,120

again it unsurprisingly nick and again

794

00:29:17,350 --> 00:29:14,960

this is you know part of a long ongoing

795

00:29:18,950 --> 00:29:17,360

conversation i i do i do disagree with

796

00:29:19,909 --> 00:29:18,960

that it's up to nasa of course whether

797

00:29:21,510 --> 00:29:19,919

this is

798

00:29:24,310 --> 00:29:21,520

going to be solely related to earth

799

00:29:26,549 --> 00:29:24,320

origins or not but i think that

800

00:29:27,750 --> 00:29:26,559

that stricture is it's a in one hand

801

00:29:29,350 --> 00:29:27,760

it's a little odd coming from somebody

802

00:29:31,750 --> 00:29:29,360

who is just arguing for a creators of

803

00:29:33,430 --> 00:29:31,760

which we have no modern examples but but

804

00:29:35,350 --> 00:29:33,440

nonetheless if we're going to restrict

805

00:29:37,430 --> 00:29:35,360

ourselves to sort of terrestrial

806

00:29:39,750 --> 00:29:37,440

chemistry and biochemistry i think we we

807

00:29:41,909 --> 00:29:39,760

do a disservice the field has focused on

808

00:29:44,310 --> 00:29:41,919

that for you know

809

00:29:46,070 --> 00:29:44,320

a long long time and i would argue

810

00:29:48,470 --> 00:29:46,080

without a whole hell of a lot of success

811

00:29:50,230 --> 00:29:48,480

and um one of the reasons for that is

812

00:29:51,909 --> 00:29:50,240

not that they're not really smart people

813

00:29:53,909 --> 00:29:51,919

working really hard but because i think

814

00:29:55,990 --> 00:29:53,919

many of these questions are ultimately

815

00:29:58,310 --> 00:29:56,000

unanswerable

816

00:30:00,389 --> 00:29:58,320

with respect to terrestrial systems we

817

00:30:02,549 --> 00:30:00,399

just will never know and i think by

818

00:30:05,350 --> 00:30:02,559

broadening it to the possibilities for

819

00:30:08,230 --> 00:30:05,360

living systems here or elsewhere

820

00:30:12,070 --> 00:30:08,240

of any of a variety of stripes we give

821

00:30:14,630 --> 00:30:12,080

nasa a broader better more answerable

822

00:30:17,430 --> 00:30:14,640

mission rather than just retreading you

823

00:30:20,389 --> 00:30:17,440

know the the origin slash exobiology

824

00:30:23,190 --> 00:30:20,399

slash astrobiology rebranding that has

825

00:30:24,950 --> 00:30:23,200

occurred so far so if anything you know

826

00:30:26,389 --> 00:30:24,960

i i would like to go exactly the

827

00:30:27,110 --> 00:30:26,399

opposite direction i would like to to

828

00:30:28,310 --> 00:30:27,120

just

829

00:30:29,990 --> 00:30:28,320

ignore

830

00:30:32,149 --> 00:30:30,000

terrestrial constraints to the greatest

831

00:30:34,950 --> 00:30:32,159

extent possible but again that's just my

832

00:30:36,630 --> 00:30:34,960

own opinion you know nasa and others

833

00:30:38,789 --> 00:30:36,640

will do what they want

834

00:30:40,549 --> 00:30:38,799

well i just agree that we haven't made

835

00:30:42,070 --> 00:30:40,559

any made major

836

00:30:43,350 --> 00:30:42,080

that we haven't accomplished anything in

837

00:30:45,510 --> 00:30:43,360

the last uh

838

00:30:47,510 --> 00:30:45,520

20 or 30 years of doing this research

839

00:30:49,510 --> 00:30:47,520

and i think that looking at modern

840

00:30:52,230 --> 00:30:49,520

biology both

841

00:30:54,549 --> 00:30:52,240

looking back through modern biology and

842

00:30:56,470 --> 00:30:54,559

understanding what order

843

00:30:58,310 --> 00:30:56,480

at least we think into a very high

844

00:30:59,990 --> 00:30:58,320

degree of confidence to different

845

00:31:02,070 --> 00:31:00,000

polymers arose

846

00:31:04,950 --> 00:31:02,080

and then also looking across

847

00:31:08,549 --> 00:31:04,960

to see at least what the constraints are

848

00:31:09,830 --> 00:31:08,559

um in modern life has been valuable um

849

00:31:11,990 --> 00:31:09,840

and we can't

850

00:31:12,870 --> 00:31:12,000

really toss that away

851

00:31:15,110 --> 00:31:12,880

uh

852

00:31:17,590 --> 00:31:15,120

because it's our only

853

00:31:19,990 --> 00:31:17,600

example where and we know that life did

854

00:31:20,789 --> 00:31:20,000

originate i agree with you that we

855

00:31:26,230 --> 00:31:20,799

should

856

00:31:27,430 --> 00:31:26,240

opinion about origins of life

857

00:31:29,430 --> 00:31:27,440

throughout

858

00:31:31,990 --> 00:31:29,440

the universe but we have this nice

859

00:31:35,590 --> 00:31:32,000

example and it's been a productive it's

860

00:31:41,350 --> 00:31:38,870

okay um let's move on and uh in the

861

00:31:43,830 --> 00:31:41,360

meantime i'll email lee and ask him to

862

00:31:45,909 --> 00:31:43,840

send us all his 3d reaction wear

863

00:31:47,909 --> 00:31:45,919

diagrams so we can print it out and do

864

00:31:48,789 --> 00:31:47,919

our experiments while we're talking

865

00:31:53,909 --> 00:31:48,799

um

866

00:31:55,990 --> 00:31:53,919

no nick should i start with you again

867

00:31:59,110 --> 00:31:56,000

role of uh if any of minerals could have

868

00:32:00,630 --> 00:31:59,120

played in early catalysis yeah i think

869

00:32:03,430 --> 00:32:00,640

that that one actually was probably

870

00:32:05,430 --> 00:32:03,440

right out of my questions on there um

871

00:32:08,389 --> 00:32:05,440

yeah it's just it's a

872

00:32:10,789 --> 00:32:08,399

it's a reoccurring question right uh

873

00:32:16,950 --> 00:32:10,799

you know we

874

00:32:19,269 --> 00:32:16,960

uh you know life probably evolved in

875

00:32:21,269 --> 00:32:19,279

contact with you know some type of

876

00:32:23,669 --> 00:32:21,279

substrate and just as michael had said

877

00:32:26,070 --> 00:32:23,679

they're not interested in life starting

878

00:32:28,149 --> 00:32:26,080

out you know in the maybe the gas phase

879

00:32:29,909 --> 00:32:28,159

it's on a planet right and if you're on

880

00:32:31,509 --> 00:32:29,919

a planet you're on a surface and if

881

00:32:33,350 --> 00:32:31,519

you're there getting life started for

882

00:32:35,590 --> 00:32:33,360

millions of years there's probably some

883

00:32:37,190 --> 00:32:35,600

type of interaction going on with what

884

00:32:38,389 --> 00:32:37,200

was the substrate

885

00:32:40,070 --> 00:32:38,399

and uh

886

00:32:41,669 --> 00:32:40,080

you know i you know i'll be the first

887

00:32:45,110 --> 00:32:41,679

one to say that i you know i'm not

888

00:32:46,630 --> 00:32:45,120

really into this really

889

00:32:49,190 --> 00:32:46,640

strong connection to the minerals where

890

00:32:51,190 --> 00:32:49,200

you have like the you know the the the

891

00:32:53,430 --> 00:32:51,200

clay replicator or something like that

892

00:32:56,470 --> 00:32:53,440

but that being said

893

00:32:59,430 --> 00:32:56,480

uh minerals are absolutely a source a

894

00:33:01,830 --> 00:32:59,440

sink of ions that could have been uh

895

00:33:03,909 --> 00:33:01,840

important um they're where you're going

896

00:33:04,870 --> 00:33:03,919

to find your phosphate if phosphate's

897

00:33:06,470 --> 00:33:04,880

where the

898

00:33:07,830 --> 00:33:06,480

that that element is going to the

899

00:33:09,909 --> 00:33:07,840

phosphorus is going to come in from so

900

00:33:11,990 --> 00:33:09,919

you have to think about that

901
00:33:13,430 --> 00:33:12,000
and then of course minerals can act as

902
00:33:15,669 --> 00:33:13,440
catalysts and there's been a lot of

903
00:33:18,149 --> 00:33:15,679
theories on on that like the iron sulfur

904
00:33:20,710 --> 00:33:18,159
ones and so i just think it's it's still

905
00:33:24,470 --> 00:33:20,720
something that's you know worth

906
00:33:25,190 --> 00:33:24,480
worth considering for sure

907
00:33:27,190 --> 00:33:25,200
so

908
00:33:29,350 --> 00:33:27,200
let me ask you based obviously on my

909
00:33:31,110 --> 00:33:29,360
very limited understanding of this has

910
00:33:34,149 --> 00:33:31,120
any of the conversation that we've

911
00:33:38,230 --> 00:33:34,159
involved so or explored so far

912
00:33:40,789 --> 00:33:38,240
involved sending probes to titan or and

913
00:33:42,950 --> 00:33:40,799

the reason i ask that is in the previous

914

00:33:45,350 --> 00:33:42,960

webinar which was about exploring solar

915

00:33:47,350 --> 00:33:45,360

systems people were very keen on all

916

00:33:50,070 --> 00:33:47,360

sorts of missions

917

00:33:52,630 --> 00:33:50,080

in terms of identifying road maps sort

918

00:33:55,110 --> 00:33:52,640

of questions and where nasa should be

919

00:33:57,430 --> 00:33:55,120

spending its money

920

00:33:59,509 --> 00:33:57,440

what does what does prebiotic chemistry

921

00:34:09,990 --> 00:33:59,519

actually require is it all lab-based

922

00:34:14,470 --> 00:34:10,869

of

923

00:34:16,550 --> 00:34:14,480

astronomical observation there um that

924

00:34:19,510 --> 00:34:16,560

understanding you know the chemistry

925

00:34:22,389 --> 00:34:19,520

that occurs elsewhere as best we can

926
00:34:24,710 --> 00:34:22,399
informs what could occur

927
00:34:26,790 --> 00:34:24,720
on a planet or wherever or what we might

928
00:34:28,149 --> 00:34:26,800
want to attempt in a lab so i would say

929
00:34:29,829 --> 00:34:28,159
that it doesn't have to only be

930
00:34:32,310 --> 00:34:29,839
experimental it could be at some level

931
00:34:34,629 --> 00:34:32,320
observational

932
00:34:35,589 --> 00:34:34,639
so what i'm really interested here is

933
00:34:40,230 --> 00:34:35,599
what

934
00:34:42,950 --> 00:34:40,240
about say in terms of the minerals

935
00:34:45,190 --> 00:34:42,960
are there particular research

936
00:34:47,990 --> 00:34:45,200
questions that if you're thinking in a

937
00:34:49,669 --> 00:34:48,000
decadal terms you'd say this is what i

938
00:34:51,669 --> 00:34:49,679

really want to know and obviously this

939

00:34:53,669 --> 00:34:51,679

question to all three of you where would

940

00:34:55,669 --> 00:34:53,679

you spend your money

941

00:34:58,150 --> 00:34:55,679

given that you have a bias to your own

942

00:34:59,750 --> 00:34:58,160

areas of knowledge

943

00:35:01,430 --> 00:34:59,760

um

944

00:35:03,990 --> 00:35:01,440

yeah i think

945

00:35:06,390 --> 00:35:04,000

yeah uh with respect to

946

00:35:09,349 --> 00:35:06,400

um

947

00:35:12,630 --> 00:35:09,359

uh you know for just as as an example on

948

00:35:13,990 --> 00:35:12,640

on the on the phosphorous one right that

949

00:35:15,670 --> 00:35:14,000

if you don't have it you don't go to

950

00:35:16,790 --> 00:35:15,680

that next stage so where was the

951
00:35:19,589 --> 00:35:16,800
phosphorus how do you get that

952
00:35:22,390 --> 00:35:19,599
phosphorus out right and and use it uh

953
00:35:23,270 --> 00:35:22,400
in the earliest system that's an example

954
00:35:24,710 --> 00:35:23,280
um

955
00:35:27,030 --> 00:35:24,720
and then

956
00:35:28,310 --> 00:35:27,040
you know what you know what came up in

957
00:35:30,150 --> 00:35:28,320
the chat window is that you know the

958
00:35:31,430 --> 00:35:30,160
study of ancient terrestrial rocks you

959
00:35:33,109 --> 00:35:31,440
know could add some context i think

960
00:35:33,990 --> 00:35:33,119
that's an important thing too because if

961
00:35:35,990 --> 00:35:34,000
you're

962
00:35:38,870 --> 00:35:36,000
you know what we we know quite well is

963
00:35:41,190 --> 00:35:38,880

that there's a incredible um

964

00:35:43,750 --> 00:35:41,200

evolution of the rocks that we have on

965

00:35:44,550 --> 00:35:43,760

earth that there was far fewer

966

00:35:48,230 --> 00:35:44,560

as

967

00:35:49,190 --> 00:35:48,240

bob hazen pointed out species early on

968

00:35:51,910 --> 00:35:49,200

and so

969

00:35:54,870 --> 00:35:51,920

you know you want to say okay

970

00:35:57,430 --> 00:35:54,880

given what was there and what we see is

971

00:35:59,829 --> 00:35:57,440

the critical reactions to make certain

972

00:36:01,510 --> 00:35:59,839

molecules uh could some of those play

973

00:36:05,750 --> 00:36:01,520

the roles i think very specific

974

00:36:10,390 --> 00:36:07,349

i i would add

975

00:36:13,270 --> 00:36:10,400

from the top down perspective there's a

976
00:36:14,790 --> 00:36:13,280
number of very ancient proteins that are

977
00:36:16,550 --> 00:36:14,800
central to

978
00:36:19,030 --> 00:36:16,560
uh

979
00:36:22,950 --> 00:36:19,040
to areas of metabolism that that we know

980
00:36:24,390 --> 00:36:22,960
are very old uh dna manufacturer or the

981
00:36:27,030 --> 00:36:24,400
generation of

982
00:36:29,750 --> 00:36:27,040
energy um through the membrane-bound

983
00:36:31,990 --> 00:36:29,760
atpase um

984
00:36:35,190 --> 00:36:32,000
the membrane the proteins associated

985
00:36:36,230 --> 00:36:35,200
with these functions uh their catalytic

986
00:36:39,670 --> 00:36:36,240
um

987
00:36:41,829 --> 00:36:39,680
pore is made up of uh inorganic

988
00:36:43,190 --> 00:36:41,839

cofactors that in many ways mimic the

989

00:36:45,349 --> 00:36:43,200

structure

990

00:36:46,150 --> 00:36:45,359

of iron sulfur minerals

991

00:36:48,550 --> 00:36:46,160

and

992

00:36:52,069 --> 00:36:48,560

organic cofactors that are derived from

993

00:36:53,670 --> 00:36:52,079

nucleotides now that could easily be

994

00:36:57,030 --> 00:36:53,680

a coincidence but it's a very

995

00:37:00,870 --> 00:36:57,040

interesting lead and i i i would like um

996

00:37:05,589 --> 00:37:03,030

just picking up a question from the chat

997

00:37:07,829 --> 00:37:05,599

window michael um

998

00:37:10,870 --> 00:37:07,839

so the the question being asked here is

999

00:37:13,510 --> 00:37:10,880

whether the window of the road map is

1000

00:37:14,310 --> 00:37:13,520

to guide research indefinitely

1001
00:37:16,310 --> 00:37:14,320
um

1002
00:37:19,030 --> 00:37:16,320
and update every five years or whether

1003
00:37:20,710 --> 00:37:19,040
we're mapping research ultimately what

1004
00:37:23,510 --> 00:37:20,720
comes out of the workshop is it rap

1005
00:37:27,750 --> 00:37:23,520
mapping research for the next five years

1006
00:37:32,630 --> 00:37:29,510
well so what i wrote in the chat window

1007
00:37:34,790 --> 00:37:32,640
is while it's true the

1008
00:37:36,790 --> 00:37:34,800
time window of this roadmap is expected

1009
00:37:37,910 --> 00:37:36,800
to be about a decade not five years a

1010
00:37:40,470 --> 00:37:37,920
decade

1011
00:37:43,109 --> 00:37:40,480
and yeah at five years out we will

1012
00:37:45,589 --> 00:37:43,119
reassess and tweak it a little bit but

1013
00:37:47,430 --> 00:37:45,599

we're not expecting massive structural

1014

00:37:51,750 --> 00:37:47,440

changes so what we say

1015

00:37:53,990 --> 00:37:51,760

in this roadmap will exist for 10 years

1016

00:37:55,990 --> 00:37:54,000

that being said mary and i nasa would

1017

00:37:59,589 --> 00:37:56,000

very much like this roadmap to be very

1018

00:38:01,349 --> 00:37:59,599

inspirational and aspirational and so

1019

00:38:03,430 --> 00:38:01,359

it's much much better

1020

00:38:05,990 --> 00:38:03,440

in my mind than i think in nasa's mind

1021

00:38:08,870 --> 00:38:06,000

to have a document that

1022

00:38:10,790 --> 00:38:08,880

thinks much bigger than 10 years than a

1023

00:38:12,550 --> 00:38:10,800

document that thinks much smaller than

1024

00:38:14,870 --> 00:38:12,560

10 years

1025

00:38:17,430 --> 00:38:14,880

once you have a bigger arc laid out it's

1026

00:38:19,589 --> 00:38:17,440

easier to go in and talk tactical

1027

00:38:20,710 --> 00:38:19,599

changes you know should we do this

1028

00:38:27,510 --> 00:38:20,720

experiment

1029

00:38:29,670 --> 00:38:27,520

do to then say all right well so we've

1030

00:38:31,349 --> 00:38:29,680

done these experiments now what does

1031

00:38:35,190 --> 00:38:31,359

that mean for us

1032

00:38:39,109 --> 00:38:37,190

maybe not a infinitely sustaining

1033

00:38:40,950 --> 00:38:39,119

program but

1034

00:38:44,230 --> 00:38:40,960

document that will guide us for at least

1035

00:38:49,349 --> 00:38:47,109

okay thank you um

1036

00:38:52,069 --> 00:38:49,359

let's go to our last question though and

1037

00:38:54,950 --> 00:38:52,079

then um i'll open it up for for the

1038

00:38:56,470 --> 00:38:54,960

audience to ask questions um

1039

00:38:58,829 --> 00:38:56,480

aaron

1040

00:38:59,430 --> 00:38:58,839

life evolving through a series

1041

00:39:02,710 --> 00:38:59,440

biopolymers thoughts

1042

00:39:08,150 --> 00:39:06,230

right um this is uh my favorite of the

1043

00:39:09,990 --> 00:39:08,160

four actually so thanks for choosing me

1044

00:39:13,270 --> 00:39:10,000

to go first um

1045

00:39:14,710 --> 00:39:13,280

so i i'm i think this is um we're

1046

00:39:16,870 --> 00:39:14,720

starting to piece together at least the

1047

00:39:18,470 --> 00:39:16,880

later what i would consider to be the

1048

00:39:20,230 --> 00:39:18,480

later stages

1049

00:39:22,470 --> 00:39:20,240

originally there might have been more

1050

00:39:23,670 --> 00:39:22,480

polymers like for example

1051
00:39:26,150 --> 00:39:23,680
um

1052
00:39:29,109 --> 00:39:26,160
it seems like it's easier to get

1053
00:39:30,390 --> 00:39:29,119
peptides than small rnas

1054
00:39:32,069 --> 00:39:30,400
um

1055
00:39:34,390 --> 00:39:32,079
chemically but uh

1056
00:39:36,390 --> 00:39:34,400
but it seems like rna was the original

1057
00:39:39,510 --> 00:39:36,400
or not the original sorry

1058
00:39:40,710 --> 00:39:39,520
at one stage rna was both the genetic

1059
00:39:42,230 --> 00:39:40,720
and functional

1060
00:39:43,670 --> 00:39:42,240
molecule and might have used other

1061
00:39:47,270 --> 00:39:43,680
functions as well

1062
00:39:50,150 --> 00:39:47,280
uh but it was the chromosomal molecule

1063
00:39:52,950 --> 00:39:50,160

then began to encode proteins then then

1064

00:39:54,870 --> 00:39:52,960

uh proteins allowed uh

1065

00:39:57,510 --> 00:39:54,880

the life form to build

1066

00:39:59,430 --> 00:39:57,520

a large dna chromosome i think this is

1067

00:40:01,270 --> 00:39:59,440

one of um it's not necessarily too

1068

00:40:03,510 --> 00:40:01,280

recent but it's one of the major

1069

00:40:06,150 --> 00:40:03,520

successes in the field of the last

1070

00:40:09,829 --> 00:40:06,160

uh couple decades and um

1071

00:40:13,270 --> 00:40:09,839

so the sort of work that

1072

00:40:14,390 --> 00:40:13,280

nick does looking at alternate um

1073

00:40:16,230 --> 00:40:14,400

polymers

1074

00:40:17,990 --> 00:40:16,240

that could have preceded this system i

1075

00:40:19,030 --> 00:40:18,000

think is very important

1076

00:40:21,750 --> 00:40:19,040

um

1077

00:40:25,030 --> 00:40:21,760

i gather the work that uh andy ellington

1078

00:40:26,630 --> 00:40:25,040

does trying to expand this system um i

1079

00:40:28,710 --> 00:40:26,640

should see is very important and i'm

1080

00:40:30,150 --> 00:40:28,720

interested in what the selection

1081

00:40:32,069 --> 00:40:30,160

pressures are

1082

00:40:34,230 --> 00:40:32,079

to start increasing

1083

00:40:37,270 --> 00:40:34,240

something um

1084

00:40:38,470 --> 00:40:37,280

more start to remove

1085

00:40:39,670 --> 00:40:38,480

um

1086

00:40:52,710 --> 00:40:39,680

the

1087

00:40:54,390 --> 00:40:52,720

as in rnas and proteins um what what are

1088

00:40:57,430 --> 00:40:54,400

the selection pressures

1089

00:40:58,390 --> 00:40:57,440

that uh drive an organism to do that and

1090

00:41:00,470 --> 00:40:58,400

how

1091

00:41:02,470 --> 00:41:00,480

very early on

1092

00:41:05,109 --> 00:41:02,480

did something as

1093

00:41:07,030 --> 00:41:05,119

elaborate as the translation system

1094

00:41:09,510 --> 00:41:07,040

arise um

1095

00:41:11,030 --> 00:41:09,520

that allowed for that to take place so

1096

00:41:13,910 --> 00:41:11,040

those are those that's what i'm mostly

1097

00:41:16,150 --> 00:41:15,030

thank you

1098

00:41:18,550 --> 00:41:16,160

nick

1099

00:41:21,030 --> 00:41:18,560

what would you add to that

1100

00:41:23,670 --> 00:41:21,040

um yeah this is a question i like a lot

1101
00:41:26,470 --> 00:41:23,680
very near and dear to my heart for sure

1102
00:41:28,150 --> 00:41:26,480
um you know i'd add that uh

1103
00:41:31,109 --> 00:41:28,160
when i look at this i also like to think

1104
00:41:32,390 --> 00:41:31,119
about what what is the simplest polymers

1105
00:41:34,870 --> 00:41:32,400
you know this is just really kind of

1106
00:41:37,990 --> 00:41:34,880
reiterated some of what aaron said but

1107
00:41:40,309 --> 00:41:38,000
you know from material availability from

1108
00:41:43,990 --> 00:41:40,319
chemical reaction what are the simplest

1109
00:41:45,750 --> 00:41:44,000
polymers that could have come about that

1110
00:41:48,390 --> 00:41:45,760
could have evolved into the ones that we

1111
00:41:50,230 --> 00:41:48,400
have today i think that that's a a

1112
00:41:51,030 --> 00:41:50,240
really really important question i think

1113
00:41:55,750 --> 00:41:51,040

that

1114

00:41:57,190 --> 00:41:55,760
spontaneous formation of a long

1115

00:41:59,829 --> 00:41:57,200
functional

1116

00:42:01,670 --> 00:41:59,839
even replicating rna is not likely so

1117

00:42:04,470 --> 00:42:01,680
there were stages that

1118

00:42:06,550 --> 00:42:04,480
built up to that and so i think that

1119

00:42:08,069 --> 00:42:06,560
connecting that to experimental systems

1120

00:42:11,750 --> 00:42:08,079
and showing

1121

00:42:14,710 --> 00:42:11,760
assembly of rudimentary proto-rna is

1122

00:42:16,870 --> 00:42:14,720
important on the peptide side

1123

00:42:20,309 --> 00:42:16,880
it's still not even a solved problem how

1124

00:42:22,950 --> 00:42:20,319
do you make a lego peptide you know five

1125

00:42:24,470 --> 00:42:22,960
or six mers in good yield in a

1126

00:42:25,990 --> 00:42:24,480

prebiotics uh

1127

00:42:27,910 --> 00:42:26,000

system and so

1128

00:42:30,390 --> 00:42:27,920

maybe esters came before that can we

1129

00:42:33,270 --> 00:42:30,400

come up with robust chemistries that

1130

00:42:35,349 --> 00:42:33,280

give us kind of a foothold onto

1131

00:42:38,309 --> 00:42:35,359

informational polymers that then can

1132

00:42:40,870 --> 00:42:38,319

evolve into the ones we have today

1133

00:42:43,670 --> 00:42:40,880

and then yet this cooperation between

1134

00:42:45,270 --> 00:42:43,680

polymers the word cooperation didn't

1135

00:42:46,710 --> 00:42:45,280

make it uh

1136

00:42:47,589 --> 00:42:46,720

in there

1137

00:42:48,870 --> 00:42:47,599

but

1138

00:42:50,950 --> 00:42:48,880

aaron talked about

1139

00:42:53,030 --> 00:42:50,960

you know kind of a series of one polymer

1140

00:42:54,790 --> 00:42:53,040

giving rise to the next i think that it

1141

00:42:57,109 --> 00:42:54,800

was important also to think about is

1142

00:42:59,109 --> 00:42:57,119

that we might not have had this kind of

1143

00:43:00,950 --> 00:42:59,119

serial development of the polymers in

1144

00:43:01,670 --> 00:43:00,960

fact i think there was a whole lot of

1145

00:43:04,150 --> 00:43:01,680

them

1146

00:43:07,030 --> 00:43:04,160

uh working along in parallel and

1147

00:43:08,470 --> 00:43:07,040

evolving and then major steps and trends

1148

00:43:10,710 --> 00:43:08,480

in evolution

1149

00:43:12,790 --> 00:43:10,720

may have been when certain polymers

1150

00:43:14,710 --> 00:43:12,800

started to cooperate like peptides

1151

00:43:16,470 --> 00:43:14,720

nucleic acids nucleic acids with

1152

00:43:17,510 --> 00:43:16,480

membranes membranes being another

1153

00:43:20,309 --> 00:43:17,520

polymer

1154

00:43:22,069 --> 00:43:20,319

of aliphatic molecules

1155

00:43:24,390 --> 00:43:22,079

um so that that's why i just add to that

1156

00:43:27,270 --> 00:43:24,400

i think it's it's captured in there

1157

00:43:29,270 --> 00:43:27,280

um but maybe it should be expanded a bit

1158

00:43:30,870 --> 00:43:29,280

a little bit more about you know uh

1159

00:43:33,670 --> 00:43:30,880

cooperation between the different types

1160

00:43:38,069 --> 00:43:35,670

really andy

1161

00:43:39,430 --> 00:43:38,079

yeah so i think that um we're sort of

1162

00:43:41,030 --> 00:43:39,440

saying much the same thing except

1163

00:43:42,230 --> 00:43:41,040

whether or not we have a historical

1164

00:43:44,630 --> 00:43:42,240

focus so

1165

00:43:45,670 --> 00:43:44,640

what kind of alphabets or chemistries we

1166

00:43:47,270 --> 00:43:45,680

have are important what the

1167

00:43:49,270 --> 00:43:47,280

potentialities of those alphabets or

1168

00:43:51,510 --> 00:43:49,280

chemistry are is important the

1169

00:43:53,510 --> 00:43:51,520

transitions between them is important we

1170

00:43:55,270 --> 00:43:53,520

either have a timeline that goes into

1171

00:43:57,109 --> 00:43:55,280

the past and is constrained by

1172

00:43:59,190 --> 00:43:57,119

terrestrial

1173

00:44:01,349 --> 00:43:59,200

you know boundary conditions or we have

1174

00:44:03,990 --> 00:44:01,359

multiple timelines that are occurring

1175

00:44:06,470 --> 00:44:04,000

elsewhere or that go into the future and

1176

00:44:09,670 --> 00:44:06,480

i'm more in favor of the of the broader

1177

00:44:12,550 --> 00:44:09,680

view but it seems like we do sort of

1178

00:44:14,150 --> 00:44:12,560

speak about the same questions um

1179

00:44:16,150 --> 00:44:14,160

you know the transitions are interesting

1180

00:44:18,150 --> 00:44:16,160

because i think even as george pointed

1181

00:44:21,510 --> 00:44:18,160

out in chat there that that you know the

1182

00:44:23,670 --> 00:44:21,520

ribosome sort of constrains our thinking

1183

00:44:24,790 --> 00:44:23,680

in a way the ribosome freaks me out i

1184

00:44:28,390 --> 00:44:24,800

mean i just don't even like to think

1185

00:44:30,309 --> 00:44:28,400

about it translation is is just weird um

1186

00:44:33,589 --> 00:44:30,319

and yet it occurred and it occurred in

1187

00:44:35,829 --> 00:44:33,599

some context and maybe you know 20

1188

00:44:37,750 --> 00:44:35,839

billion years from now you know somebody

1189

00:44:39,430 --> 00:44:37,760

you know the the nick hud of alpha

1190

00:44:41,510 --> 00:44:39,440

centauri will be arguing about why we

1191

00:44:43,910 --> 00:44:41,520

have these you know silicon organic

1192

00:44:46,309 --> 00:44:43,920

things um where the organic parts are

1193

00:44:47,750 --> 00:44:46,319

this weird heterocyclic compound and

1194

00:44:49,430 --> 00:44:47,760

where did that come from i mean i can

1195

00:44:51,910 --> 00:44:49,440

imagine you know further transitions in

1196

00:44:53,670 --> 00:44:51,920

in our own evolution where

1197

00:44:55,510 --> 00:44:53,680

it would be hard to look backwards and

1198

00:44:57,270 --> 00:44:55,520

see how it happened so i just sort of

1199

00:44:59,270 --> 00:44:57,280

disregard translation because it's just

1200

00:45:01,190 --> 00:44:59,280

too weird and i don't think i'm ever

1201

00:45:04,470 --> 00:45:01,200

ever ever going to know enough to figure

1202

00:45:06,309 --> 00:45:04,480

out anything about where it came from so

1203

00:45:08,950 --> 00:45:06,319

you know these transitions can be as

1204

00:45:12,390 --> 00:45:08,960

stark as translation or as silicon

1205

00:45:15,030 --> 00:45:12,400

organic you know chimeras or they can be

1206

00:45:16,870 --> 00:45:15,040

um you know milder transitions you know

1207

00:45:20,550 --> 00:45:16,880

uh pna to

1208

00:45:22,710 --> 00:45:20,560

to dna or ester to phosphate or what or

1209

00:45:24,950 --> 00:45:22,720

whatever and

1210

00:45:26,870 --> 00:45:24,960

you know these are these are worth these

1211

00:45:28,390 --> 00:45:26,880

are all worth studying i think that we

1212

00:45:29,270 --> 00:45:28,400

should just study them in a context

1213

00:45:31,829 --> 00:45:29,280

where

1214

00:45:33,270 --> 00:45:31,839

we have a common language and a common

1215

00:45:34,710 --> 00:45:33,280

way to compare

1216

00:45:36,069 --> 00:45:34,720

what it is we're trying to accomplish i

1217

00:45:37,190 --> 00:45:36,079

think that's more than anything what i'd

1218

00:45:39,030 --> 00:45:37,200

like to come from some of these

1219

00:45:40,710 --> 00:45:39,040

discussions is that we can speak

1220

00:45:41,589 --> 00:45:40,720

together as a community

1221

00:45:45,670 --> 00:45:41,599

and

1222

00:45:50,069 --> 00:45:45,680

ideas

1223

00:45:55,190 --> 00:45:52,710

okay well at that

1224

00:45:57,589 --> 00:45:55,200

let me um let me pick up on the idea of

1225

00:46:00,069 --> 00:45:57,599

speaking as a community

1226

00:46:01,829 --> 00:46:00,079

we have a few minutes left on this

1227

00:46:04,150 --> 00:46:01,839

session and i'm i'm conscious that i

1228

00:46:07,270 --> 00:46:04,160

don't want to overrun because people

1229

00:46:09,430 --> 00:46:07,280

have given us their time um if anyone

1230

00:46:11,030 --> 00:46:09,440

wants to ask a question

1231

00:46:12,950 --> 00:46:11,040

mike is going to

1232

00:46:15,270 --> 00:46:12,960

open all the mics

1233

00:46:17,190 --> 00:46:15,280

at the top of your screen over here

1234

00:46:19,190 --> 00:46:17,200

online you'll find a little icon of the

1235

00:46:21,270 --> 00:46:19,200

person with their hand held up and it

1236

00:46:24,230 --> 00:46:21,280

seemed to work quite well last time if

1237

00:46:26,309 --> 00:46:24,240

you want to ask a question make a point

1238

00:46:27,670 --> 00:46:26,319

just click on that and your name will

1239

00:46:28,470 --> 00:46:27,680

pop to the top of the list and then

1240

00:46:34,470 --> 00:46:28,480

we'll

1241

00:46:40,309 --> 00:46:36,550

we encourage people to vehemently

1242

00:47:07,430 --> 00:46:44,309

so taking the broad topic of prebiotics

1243

00:47:12,710 --> 00:47:09,670

in that case if the if the panelists

1244

00:47:13,910 --> 00:47:12,720

have covered the subject in such perfect

1245

00:47:15,190 --> 00:47:13,920

detail

1246

00:47:21,109 --> 00:47:15,200

um

1247

00:47:30,069 --> 00:47:21,119

the uh

1248

00:47:33,430 --> 00:47:31,030

great

1249

00:47:35,829 --> 00:47:33,440

it's possible that uh that some of you

1250

00:47:37,910 --> 00:47:35,839

may not be registered on the website or

1251

00:47:39,190 --> 00:47:37,920

may not even know about it if you've

1252

00:47:41,349 --> 00:47:39,200

discovered about this webinar through

1253

00:47:44,150 --> 00:47:41,359

another route so i just wanted to show

1254

00:47:46,109 --> 00:47:44,160

you very briefly yeah thank you the

1255

00:47:47,990 --> 00:47:46,119

website address

1256

00:47:51,030 --> 00:47:48,000

astrobiologyfuture.org and then mike if

1257

00:47:53,030 --> 00:47:51,040

you scroll down ever so slightly

1258

00:47:56,069 --> 00:47:53,040

um you'll see that in the middle of the

1259

00:47:59,349 --> 00:47:56,079

screen now it says share your thoughts

1260

00:48:01,030 --> 00:47:59,359

and just below that um it says click on

1261

00:48:04,230 --> 00:48:01,040

this link so i'm just going to show you

1262

00:48:07,670 --> 00:48:04,240

if we click there for a moment

1263

00:48:10,630 --> 00:48:07,680

what we have now is we've set up

1264

00:48:14,069 --> 00:48:10,640

three uh discussion areas the advanced

1265

00:48:16,710 --> 00:48:14,079

life one is for our three o'clock east

1266

00:48:19,670 --> 00:48:16,720

coast session coming up soon do not miss

1267

00:48:22,069 --> 00:48:19,680

it um but further down we've got our

1268

00:48:24,150 --> 00:48:22,079

prebiotic life one and at the moment

1269

00:48:26,230 --> 00:48:24,160

we've just got two sections there ideas

1270

00:48:28,870 --> 00:48:26,240

and questions you'll see that for the

1271

00:48:30,549 --> 00:48:28,880

solar system exploration one above we

1272

00:48:32,950 --> 00:48:30,559

also have the transcript from the

1273

00:48:35,430 --> 00:48:32,960

meeting chat and this will be added in

1274

00:48:39,910 --> 00:48:35,440

here as well but what i'd like to do is

1275

00:48:41,829 --> 00:48:39,920

to encourage people to uh to go over to

1276

00:48:43,270 --> 00:48:41,839

the site go to the prebiotic live

1277

00:48:45,190 --> 00:48:43,280

section and particularly on the

1278

00:48:46,390 --> 00:48:45,200

questions there there is a larger

1279

00:48:48,390 --> 00:48:46,400

collection of questions and it's

1280

00:48:51,430 --> 00:48:48,400

actually going to be updated

1281

00:48:52,710 --> 00:48:51,440

shortly um i just got a couple more from

1282

00:48:55,750 --> 00:48:52,720

the panelists

1283

00:48:57,349 --> 00:48:55,760

um and please go and add your thoughts

1284

00:48:59,829 --> 00:48:57,359

on that now i can see someone has

1285

00:49:01,030 --> 00:48:59,839

already um

1286

00:49:03,109 --> 00:49:01,040

so

1287

00:49:04,470 --> 00:49:03,119

that's what we're we're going to do i

1288

00:49:07,349 --> 00:49:04,480

did see one

1289

00:49:08,870 --> 00:49:07,359

question appearing in the oh yes android

1290

00:49:11,990 --> 00:49:08,880

about um

1291

00:49:14,790 --> 00:49:12,000

obviously several while i was talking

1292

00:49:18,069 --> 00:49:14,800

all right let me um let me make a

1293

00:49:20,630 --> 00:49:18,079

suggestion in that case uh if there is a

1294

00:49:21,670 --> 00:49:20,640

question here that you want to have

1295

00:49:25,270 --> 00:49:21,680

covered

1296

00:49:27,750 --> 00:49:25,280

and our our panelists are going to be um

1297

00:49:30,309 --> 00:49:27,760

engaged with the science next week or so

1298

00:49:33,030 --> 00:49:30,319

feel free to add your own question in

1299

00:49:34,710 --> 00:49:33,040

into the prebiotic and when you're doing

1300

00:49:36,309 --> 00:49:34,720

that please take the time to add your

1301

00:49:38,870 --> 00:49:36,319

thoughts to this it really is very

1302

00:49:42,309 --> 00:49:38,880

important to help nasa shape their

1303

00:49:44,630 --> 00:49:42,319

workshop and the resulting roadmap

1304

00:49:47,430 --> 00:49:44,640

uh and with that

1305

00:49:49,270 --> 00:49:47,440

i think we will draw it to an end unless

1306

00:49:51,750 --> 00:49:49,280

anyone wants to stick a hand in the air

1307

00:49:53,030 --> 00:49:51,760

in their last moment

1308

00:49:55,109 --> 00:49:53,040

and

1309

00:49:57,349 --> 00:49:55,119

mike mike what is what is advanced life

1310

00:49:58,790 --> 00:49:57,359

have we inadvertently tread upon your

1311

00:50:00,309 --> 00:49:58,800

other session i don't i don't quite

1312

00:50:02,950 --> 00:50:00,319

understand the distinction

1313

00:50:05,829 --> 00:50:02,960

oh sorry yeah um we tend to use

1314

00:50:07,750 --> 00:50:05,839

evolution of advanced life to talk about

1315

00:50:09,510 --> 00:50:07,760

a couple of things

1316

00:50:11,829 --> 00:50:09,520

the title comes from looking at the

1317

00:50:14,630 --> 00:50:11,839

transition from unicellular life to

1318

00:50:17,190 --> 00:50:14,640

multicellular life and all of the

1319

00:50:18,870 --> 00:50:17,200

evolutionary changes that occurred in

1320

00:50:20,710 --> 00:50:18,880

that process

1321

00:50:22,630 --> 00:50:20,720

we also in there tend to include the

1322

00:50:25,589 --> 00:50:22,640

response of

1323

00:50:26,870 --> 00:50:25,599

the causes and responses of ecosystems

1324

00:50:30,150 --> 00:50:26,880

to

1325

00:50:32,470 --> 00:50:30,160

uh um mass extinction events impact

1326

00:50:35,030 --> 00:50:32,480

flood volcanism that kind of thing

1327

00:50:36,630 --> 00:50:35,040

so it's on the it sort of squishes

1328

00:50:38,790 --> 00:50:36,640

together um

1329

00:50:41,829 --> 00:50:38,800

issues in developmental evolutionary

1330

00:50:44,470 --> 00:50:41,839

biology and issues in sort of macro

1331

00:50:46,549 --> 00:50:44,480

evolutionary paleontology

1332

00:50:48,710 --> 00:50:46,559

okay so our various discussions of you

1333

00:50:50,309 --> 00:50:48,720

know the role of chemistry and either

1334

00:50:51,990 --> 00:50:50,319

origins or the expansion of

1335

00:50:54,470 --> 00:50:52,000

functionality are are perfectly

1336

00:50:56,710 --> 00:50:54,480

legitimate under the prebiotic banner

1337

00:50:58,870 --> 00:50:56,720

ab absolutely and they're probably more

1338

00:50:59,910 --> 00:50:58,880

easily tackled they don't know it's a

1339

00:51:03,430 --> 00:50:59,920

question where they're more easily

1340

00:51:05,270 --> 00:51:03,440

tackled in the prebiotic mildew or in

1341

00:51:06,950 --> 00:51:05,280

one or in the advanced life familiar

1342

00:51:09,190 --> 00:51:06,960

where you've already got a fairly

1343

00:51:11,910 --> 00:51:09,200

complex system of genetic control

1344

00:51:13,990 --> 00:51:11,920

already established

1345

00:51:15,589 --> 00:51:14,000

i i'd be concerned that some of the

1346

00:51:17,349 --> 00:51:15,599

fundamental issues would fall through

1347

00:51:18,230 --> 00:51:17,359

the cracks

1348

00:51:20,150 --> 00:51:18,240

so

1349

00:51:26,230 --> 00:51:20,160

i would like to err on the side of

1350

00:51:32,069 --> 00:51:29,750

i i didn't mean to imply that uh um

1351
00:51:32,870 --> 00:51:32,079
robotic evolution was simple

1352
00:51:34,230 --> 00:51:32,880
um

1353
00:51:36,390 --> 00:51:34,240
just that we tend to think of of

1354
00:51:38,390 --> 00:51:36,400
unicellular life and multicellular life

1355
00:51:40,150 --> 00:51:38,400
and historically multicellular life

1356
00:51:41,990 --> 00:51:40,160
animals have been considered advanced

1357
00:51:43,829 --> 00:51:42,000
life and so that's where we grab the

1358
00:51:45,430 --> 00:51:43,839
words if you think of a better title i'd

1359
00:51:47,270 --> 00:51:45,440
be happy to accept

1360
00:51:48,870 --> 00:51:47,280
honestly sorry i was actually referring

1361
00:51:50,790 --> 00:51:48,880
to next week's

1362
00:51:52,069 --> 00:51:50,800
discussion on early evolution which

1363
00:51:53,270 --> 00:51:52,079

probably will have a lot of problems

1364

00:51:54,950 --> 00:51:53,280

here

1365

00:51:56,549 --> 00:51:54,960

oh the early evolution generally means

1366

00:51:57,430 --> 00:51:56,559

once you've got a living system what

1367

00:51:59,670 --> 00:51:57,440

happens

1368

00:52:01,750 --> 00:51:59,680

okay that's kind of arbitrarily where we

1369

00:52:04,470 --> 00:52:01,760

draw the the border

1370

00:52:06,390 --> 00:52:04,480

um but my comment stands i if you have

1371

00:52:09,510 --> 00:52:06,400

better titles for these things i would

1372

00:52:14,309 --> 00:52:12,230

okay just two points uh damien had

1373

00:52:16,309 --> 00:52:14,319

raised his hand just while i was talking

1374

00:52:17,750 --> 00:52:16,319

he he's added the question into the chat

1375

00:52:20,710 --> 00:52:17,760

window and i can see that andy's

1376
00:52:22,710 --> 00:52:20,720
responded but just for aaron and nick so

1377
00:52:25,190 --> 00:52:22,720
he's asking um the panel talked a bit

1378
00:52:27,910 --> 00:52:25,200
about replicators in general any general

1379
00:52:30,470 --> 00:52:27,920
model is defined by a set of constraints

1380
00:52:31,829 --> 00:52:30,480
um and what the model does not model

1381
00:52:37,349 --> 00:52:31,839
what would the panelists see as the

1382
00:52:41,430 --> 00:52:38,710
yeah i think so

1383
00:52:45,109 --> 00:52:43,510
um yeah so i i think that that's

1384
00:52:47,670 --> 00:52:45,119
actually a really good point because

1385
00:52:48,470 --> 00:52:47,680
this is uh it goes back to um i think

1386
00:52:52,069 --> 00:52:48,480
that

1387
00:52:53,990 --> 00:52:52,079
uh andy and my definition of of these

1388
00:52:56,150 --> 00:52:54,000

systems that he was calling at creators

1389

00:52:57,990 --> 00:52:56,160

are a bit different and he says there

1390

00:53:00,230 --> 00:52:58,000

isn't an example

1391

00:53:02,710 --> 00:53:00,240

of those out there and i'll just throw

1392

00:53:05,750 --> 00:53:02,720

out you know an example i see

1393

00:53:08,390 --> 00:53:05,760

in a sense is the the propagation of

1394

00:53:10,309 --> 00:53:08,400

peptides that form amyloid is all over

1395

00:53:13,109 --> 00:53:10,319

the scientific literature

1396

00:53:16,790 --> 00:53:13,119

and you know some of the models for why

1397

00:53:19,589 --> 00:53:16,800

do these uh build up is that the

1398

00:53:21,349 --> 00:53:19,599

proteases cannot cleave up peptides in

1399

00:53:22,470 --> 00:53:21,359

the amyloids as well as they can free

1400

00:53:23,430 --> 00:53:22,480

peptides

1401
00:53:24,870 --> 00:53:23,440
and so

1402
00:53:26,309 --> 00:53:24,880
when andy talks about a creator it

1403
00:53:27,589 --> 00:53:26,319
sounds like he's talking about one

1404
00:53:29,990 --> 00:53:27,599
simple

1405
00:53:31,829 --> 00:53:30,000
single molecule entity and i'm talking

1406
00:53:33,990 --> 00:53:31,839
about them coming together and doing

1407
00:53:36,390 --> 00:53:34,000
something that promotes their own

1408
00:53:37,910 --> 00:53:36,400
survival and that's a you know a type of

1409
00:53:39,030 --> 00:53:37,920
self-selection

1410
00:53:40,790 --> 00:53:39,040
and so

1411
00:53:43,510 --> 00:53:40,800
you know that's where with respect to

1412
00:53:45,589 --> 00:53:43,520
replicator pretty much everybody has you

1413
00:53:47,430 --> 00:53:45,599

know in the modeling said

1414

00:53:49,829 --> 00:53:47,440

molly field gives rise to a copy of

1415

00:53:51,750 --> 00:53:49,839

itself well okay that's

1416

00:53:54,790 --> 00:53:51,760

that's you know strictly speaking that's

1417

00:53:57,990 --> 00:53:54,800

a replication but we could also have

1418

00:54:01,190 --> 00:53:58,000

a broader sense of it where

1419

00:54:04,309 --> 00:54:01,200

oligos are being produced and then

1420

00:54:07,750 --> 00:54:04,319

by their association they are then

1421

00:54:09,990 --> 00:54:07,760

living on right a longer time and that's

1422

00:54:12,069 --> 00:54:10,000

a selection of two and so that's a

1423

00:54:13,589 --> 00:54:12,079

little broader definition perhaps of

1424

00:54:16,950 --> 00:54:13,599

replication

1425

00:54:16,960 --> 00:54:21,030

that's a great example

1426

00:54:25,829 --> 00:54:22,309

sorry go ahead

1427

00:54:29,349 --> 00:54:25,839

as i was just going to say i agree uh

1428

00:54:32,230 --> 00:54:29,359

with both um nick and andy and it only

1429

00:54:35,670 --> 00:54:32,240

had that for me it is more important

1430

00:54:38,390 --> 00:54:35,680

that it's capable of um uh evolving in a

1431

00:54:44,630 --> 00:54:38,400

manner that we would recognize uh as

1432

00:54:50,230 --> 00:54:47,750

okay i am going to draw it to a close

1433

00:54:52,630 --> 00:54:50,240

now but i just wanted to address

1434

00:54:55,190 --> 00:54:52,640

aaron's question about how does the

1435

00:54:57,829 --> 00:54:55,200

information from the discussion and the

1436

00:54:59,349 --> 00:54:57,839

chat windows feed into the roadmap

1437

00:55:02,470 --> 00:54:59,359

workshop

1438

00:55:06,789 --> 00:55:02,480

uh and the answer is that we're using

1439

00:55:09,589 --> 00:55:06,799

these webinars and the website to um to

1440

00:55:11,910 --> 00:55:09,599

broaden the the discussion in uh there's

1441

00:55:15,510 --> 00:55:11,920

a more diverse community to give

1442

00:55:17,510 --> 00:55:15,520

insights to the questions that might be

1443

00:55:19,349 --> 00:55:17,520

part of the road mapping workshop so

1444

00:55:21,670 --> 00:55:19,359

really at this moment all we're doing is

1445

00:55:24,470 --> 00:55:21,680

data gathering in order to allow us to

1446

00:55:27,270 --> 00:55:24,480

get together for for three ish days to

1447

00:55:29,750 --> 00:55:27,280

have the academic debate um

1448

00:55:33,829 --> 00:55:29,760

so that's the purpose of

1449

00:55:34,950 --> 00:55:33,839

both the webinars and the website

1450

00:55:37,109 --> 00:55:34,960

um

1451

00:55:39,910 --> 00:55:37,119

so with that thank you very much

1452

00:55:42,150 --> 00:55:39,920

everyone um i will see some of you i

1453

00:55:44,390 --> 00:55:42,160

hope possibly all of you in uh an hour