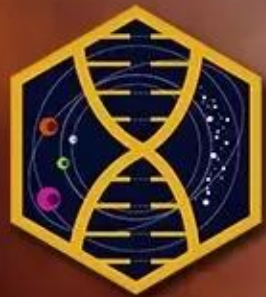


# Analysis of Trace Amino Acids in Europa Analogues

Dr. Zachary Duca



Georgia Tech Astrobiology

1  
00:00:00,820 --> 00:00:09,250

[Music]

2  
00:00:14,360 --> 00:00:12,290

okay so last talk of the day hopefully I

3  
00:00:16,250 --> 00:00:14,370

can end this on a good note or at least

4  
00:00:19,370 --> 00:00:16,260

someone get us out of here as you go

5  
00:00:21,230 --> 00:00:19,380

into the brewery mr. rich mentioned Zach

6  
00:00:23,570 --> 00:00:21,240

Duke I'm part of dr. Amanda Stockton's

7  
00:00:26,689 --> 00:00:23,580

group here and a fourth-year grad

8  
00:00:28,130 --> 00:00:26,699

students and actually what I'm talking

9  
00:00:30,950 --> 00:00:28,140

about today is part of some of the

10  
00:00:33,170 --> 00:00:30,960

research I did starting around my second

11  
00:00:35,180 --> 00:00:33,180

year of grad school and it's really been

12  
00:00:37,690 --> 00:00:35,190

a great journey along the way so far

13  
00:00:40,400 --> 00:00:37,700

because we are a relatively new group

14

00:00:42,080 --> 00:00:40,410

which means I've had to do a lot of this

15

00:00:44,479 --> 00:00:42,090

research from the ground up so it's been

16

00:00:45,950 --> 00:00:44,489

a really educational experience and I'm

17

00:00:48,520 --> 00:00:45,960

definitely spoiled being at Georgia Tech

18

00:00:51,680 --> 00:00:48,530

for the astrobiology community because

19

00:00:53,299 --> 00:00:51,690

just based on today we truly do have a

20

00:00:55,450 --> 00:00:53,309

wonderful community to share our science

21

00:00:59,360 --> 00:00:55,460

and to which we can share our science

22

00:01:00,740 --> 00:00:59,370

which I get to do today and I don't know

23

00:01:03,020 --> 00:01:00,750

if you've been to the posters outside

24

00:01:05,329 --> 00:01:03,030

yet but if you may have noticed that

25

00:01:07,789 --> 00:01:05,339

maybe roughly half of them are from our

26

00:01:09,800 --> 00:01:07,799

group and I think that tells us two

27

00:01:15,230 --> 00:01:09,810

things one we're doing some really

28

00:01:17,359 --> 00:01:15,240

awesome science and two we have most of

29

00:01:18,410 --> 00:01:17,369

our science is related to astrobiology

30

00:01:22,999 --> 00:01:18,420

research so realize the perfect

31

00:01:25,520 --> 00:01:23,009

environment environment for us and cool

32

00:01:27,679 --> 00:01:25,530

this actually does work so one picture

33

00:01:29,600 --> 00:01:27,689

would like to show this being an

34

00:01:31,039 --> 00:01:29,610

astrobiology related talk one one

35

00:01:34,069 --> 00:01:31,049

picture we always like to show to put

36

00:01:36,170 --> 00:01:34,079

into perspective how difficult some of

37

00:01:39,590 --> 00:01:36,180

the analyses can be as a picture of

38

00:01:43,660 --> 00:01:39,600

Earth taken at Mars by the spirit rover

39

00:01:46,910 --> 00:01:43,670

and this shows you a few things and

40

00:01:50,950 --> 00:01:46,920

gives you some design constraints and

41

00:01:53,450 --> 00:01:50,960

restrictions to build your equipment and

42

00:01:55,310 --> 00:01:53,460

listed right here everything yet you

43

00:01:57,080 --> 00:01:55,320

build has to be small energy efficient

44

00:01:58,940 --> 00:01:57,090

and fully automated and it's it's

45

00:02:01,340 --> 00:01:58,950

absolutely critical that you meet these

46

00:02:03,530 --> 00:02:01,350

restrictions based on the equipment you

47

00:02:05,300 --> 00:02:03,540

selects because NASA is looking for them

48

00:02:08,690 --> 00:02:05,310

so if you're not meeting these at the

49

00:02:09,919 --> 00:02:08,700

get-go you're very low chance that

50

00:02:13,640 --> 00:02:09,929

you're gonna be selecting these missions

51

00:02:14,630 --> 00:02:13,650

so what we're looking for

52

00:02:16,009 --> 00:02:14,640

or and what we're designing our

53

00:02:17,990 --> 00:02:16,019

equipment to be is to fit these

54

00:02:20,240 --> 00:02:18,000

restrictions in order to get to these

55

00:02:22,699 --> 00:02:20,250

extreme locations and the outer solar

56

00:02:25,220 --> 00:02:22,709

system like I showed on the previous

57

00:02:28,789 --> 00:02:25,230

slide Europa here which is our main

58

00:02:31,039 --> 00:02:28,799

target of interest and what we're seeing

59

00:02:32,720 --> 00:02:31,049

is for our systems at least in the one

60

00:02:34,670 --> 00:02:32,730

in particular what I've been designing

61

00:02:36,110 --> 00:02:34,680

is micro capillary electrophoresis laser

62

00:02:37,699 --> 00:02:36,120

and flute induced for licence I'll get

63

00:02:39,380 --> 00:02:37,709

into that a little bit and a little bit

64

00:02:41,210 --> 00:02:39,390

but it's a detection technique it's a

65

00:02:43,460 --> 00:02:41,220

separation and detection technique for

66

00:02:45,319 --> 00:02:43,470

small molecule organics and the whole

67

00:02:46,670 --> 00:02:45,329

idea behind that is to go to some of

68

00:02:49,490 --> 00:02:46,680

these locations that are very far away

69

00:02:52,309 --> 00:02:49,500

and look for signs of life and in

70

00:02:54,380 --> 00:02:52,319

particular this is of Mars we're going

71

00:02:56,930 --> 00:02:54,390

to you're planning on hopefully going to

72

00:02:58,819 --> 00:02:56,940

Europa this is even further away so it's

73

00:03:01,009 --> 00:02:58,829

again essential that our equipment can

74

00:03:01,720 --> 00:03:01,019

meet all these design constraints and

75

00:03:06,349 --> 00:03:01,730

constraints

76  
00:03:08,630 --> 00:03:06,359  
why Europa many of you probably seen

77  
00:03:10,399 --> 00:03:08,640  
these pictures before but if you take a

78  
00:03:13,300 --> 00:03:10,409  
look at this picture on the left you see

79  
00:03:16,220 --> 00:03:13,310  
all these dark spots we have sent

80  
00:03:18,559 --> 00:03:16,230  
equipment out here in the past to look

81  
00:03:20,930 --> 00:03:18,569  
at these recurring slope lineae and what

82  
00:03:23,360 --> 00:03:20,940  
we've seen is that it's giving evidence

83  
00:03:26,720 --> 00:03:23,370  
of global tidal heating underneath the

84  
00:03:29,150 --> 00:03:26,730  
icy crust so for one thing it's an icy

85  
00:03:30,710 --> 00:03:29,160  
surface so this is great news for us

86  
00:03:33,530 --> 00:03:30,720  
because life as we know it on earth

87  
00:03:35,240 --> 00:03:33,540  
needs water to survive so this is a

88  
00:03:37,039 --> 00:03:35,250

great starting point if there's water on

89

00:03:38,839 --> 00:03:37,049

the surface that could possibly mean

90

00:03:42,409 --> 00:03:38,849

that there are components for a life

91

00:03:44,360 --> 00:03:42,419

mixture and to that is giving us

92

00:03:46,909 --> 00:03:44,370

evidence of subsurface ocean underneath

93

00:03:49,909 --> 00:03:46,919

this icy crust and again on earth here

94

00:03:51,589 --> 00:03:49,919

we see these hydrothermal vent systems

95

00:03:53,270 --> 00:03:51,599

at the bottom of the ocean so it gives

96

00:03:54,619 --> 00:03:53,280

us a great opportunity or at least

97

00:03:55,750 --> 00:03:54,629

possibility of finding life at these

98

00:03:58,369 --> 00:03:55,760

locations

99

00:04:00,259 --> 00:03:58,379

another critical aspects about Europa

100

00:04:03,259 --> 00:04:00,269

surface when you're looking at these

101

00:04:07,879 --> 00:04:03,269

dark spots is what we can actually

102

00:04:09,710 --> 00:04:07,889

determine is in them so we have sense so

103

00:04:12,589 --> 00:04:09,720

this is the Galileo's near infrared

104

00:04:14,240 --> 00:04:12,599

mapping spectrometer or NIMS mapped out

105

00:04:18,170 --> 00:04:14,250

the surface of these dark spots on the

106

00:04:20,750 --> 00:04:18,180

Sun Europa and what they found is after

107

00:04:22,370 --> 00:04:20,760

some modelling that there are these

108

00:04:26,330 --> 00:04:22,380

magnesium sulfate and sodium carbonate

109

00:04:27,060 --> 00:04:26,340

hydrated salts and so we can know what

110

00:04:31,590 --> 00:04:27,070

the

111

00:04:34,380 --> 00:04:31,600

just water but we don't know what else

112

00:04:37,890 --> 00:04:34,390

is in it is in those materials so

113

00:04:40,620 --> 00:04:37,900

ideally we want to go there and since we

114

00:04:43,160 --> 00:04:40,630

know what we're what type of ionic

115

00:04:45,330 --> 00:04:43,170

content is in there we can plan for our

116

00:04:47,370 --> 00:04:45,340

experiments that we eventually will send

117

00:04:49,470 --> 00:04:47,380

there and look for more indicators of

118

00:04:51,420 --> 00:04:49,480

life and this is actually perfect for

119

00:04:53,850 --> 00:04:51,430

some of our other previously designed

120

00:04:55,880 --> 00:04:53,860

concepts one in particular is an

121

00:04:58,350 --> 00:04:55,890

impactor type mission that we've been

122

00:05:01,590 --> 00:04:58,360

contemplating and trying to design some

123

00:05:03,810 --> 00:05:01,600

optical equipment for another critical

124

00:05:05,490 --> 00:05:03,820

aspect about Europa is more recently

125

00:05:08,760 --> 00:05:05,500

discovered its South Pole these

126

00:05:11,220 --> 00:05:08,770

transient water vapors that again can

127

00:05:15,710 --> 00:05:11,230

suggest other materials

128

00:05:19,320 --> 00:05:15,720

besides these salts salt magnesium salts

129

00:05:20,220 --> 00:05:19,330

and this like and if anybody here is

130

00:05:22,200 --> 00:05:20,230

heard of Enceladus

131

00:05:24,900 --> 00:05:22,210

but this is a similar situation of

132

00:05:26,400 --> 00:05:24,910

Enceladus where we can more easily just

133

00:05:28,890 --> 00:05:26,410

fly through these plumes at the South

134

00:05:31,110 --> 00:05:28,900

Pole and collect our samples so it's a

135

00:05:32,430 --> 00:05:31,120

little more simple to design and equip a

136

00:05:32,940 --> 00:05:32,440

piece of equipment to fly through these

137

00:05:36,270 --> 00:05:32,950

plumes

138

00:05:38,070 --> 00:05:36,280

around the planet or around the the moon

139

00:05:39,870 --> 00:05:38,080

instead of just crashing into it or

140

00:05:41,760 --> 00:05:39,880

landing on the surface it simplifies

141

00:05:44,880 --> 00:05:41,770

your design a bit so this is really a

142

00:05:47,100 --> 00:05:44,890

more ideal situation but before you can

143

00:05:48,840 --> 00:05:47,110

just send all of this technology that's

144

00:05:51,210 --> 00:05:48,850

really small and miniaturized and

145

00:05:53,610 --> 00:05:51,220

perfect for your situation out to these

146

00:05:56,820 --> 00:05:53,620

outer solar system places you need to

147

00:05:59,910 --> 00:05:56,830

make sure that it works here first NASA

148

00:06:02,130 --> 00:05:59,920

really is never going to let you just

149

00:06:04,380 --> 00:06:02,140

send whatever you want to wherever you

150

00:06:06,150 --> 00:06:04,390

want they need to know that it's working

151  
00:06:09,540 --> 00:06:06,160  
here first and you really have to

152  
00:06:11,940 --> 00:06:09,550  
everything everything down down pat way

153  
00:06:14,520 --> 00:06:11,950  
ahead of the game so what I ended up

154  
00:06:17,220 --> 00:06:14,530  
having to do my first year having to do

155  
00:06:20,400 --> 00:06:17,230  
I actually really enjoyed it is calling

156  
00:06:22,710 --> 00:06:20,410  
a bunch of companies getting them to

157  
00:06:24,150 --> 00:06:22,720  
send me quote some materials waiting for

158  
00:06:25,860 --> 00:06:24,160  
those but buying the materials waiting

159  
00:06:27,540 --> 00:06:25,870  
for those materials to come in and then

160  
00:06:30,900 --> 00:06:27,550  
putting a bunch of pieces together to

161  
00:06:34,710 --> 00:06:30,910  
make an optical equipment as an in lab

162  
00:06:37,290 --> 00:06:34,720  
analog or model system for to compare to

163  
00:06:39,750 --> 00:06:37,300

later design miniaturized designs of our

164

00:06:40,589 --> 00:06:39,760

detection system and what that ends up

165

00:06:42,480 --> 00:06:40,599

looking like

166

00:06:44,639 --> 00:06:42,490

when you model out all these components

167

00:06:47,579 --> 00:06:44,649

these commercially available components

168

00:06:49,320 --> 00:06:47,589

is this so I will go ahead and go

169

00:06:52,260 --> 00:06:49,330

through some of the more important

170

00:06:55,889 --> 00:06:52,270

components of this system to explain

171

00:06:58,139 --> 00:06:55,899

what how laser how it works and what

172

00:06:59,820 --> 00:06:58,149

what components are really the core

173

00:07:03,510 --> 00:06:59,830

essentials to miniaturizing the system

174

00:07:06,499 --> 00:07:03,520

so first page engineer give a laser that

175

00:07:09,799 --> 00:07:06,509

comes out here it shines in through your

176

00:07:13,290 --> 00:07:09,809

two lens tubes here and it hits this

177

00:07:14,879 --> 00:07:13,300

this cube in the middle and one design

178

00:07:17,309 --> 00:07:14,889

consideration that I really wanted to

179

00:07:19,199 --> 00:07:17,319

make sure was critical to this modular

180

00:07:21,980 --> 00:07:19,209

benchtop system is this cube in the

181

00:07:24,480 --> 00:07:21,990

middle here which contains your entire

182

00:07:26,790 --> 00:07:24,490

filter system for your your laser light

183

00:07:29,760 --> 00:07:26,800

in your fluorescence light you have

184

00:07:31,980 --> 00:07:29,770

what's in here a bandpass and a long

185

00:07:33,540 --> 00:07:31,990

pass filter and a dichroic which

186

00:07:35,909 --> 00:07:33,550

separates your florescent light from

187

00:07:37,829 --> 00:07:35,919

your laser light making it so for when

188

00:07:39,570 --> 00:07:37,839

your laser light hits your sample up

189

00:07:41,489 --> 00:07:39,580

here and your fluorescence is collected

190

00:07:43,259 --> 00:07:41,499

back down you don't have your detector

191

00:07:44,339 --> 00:07:43,269

your detector isn't drowned out regular

192

00:07:46,799 --> 00:07:44,349

light so this is a really critical

193

00:07:48,839 --> 00:07:46,809

component to the laser optics system and

194

00:07:51,719 --> 00:07:48,849

what's nice about this it's a magnetic

195

00:07:53,790 --> 00:07:51,729

cube so if you ever need to change out

196

00:07:55,320 --> 00:07:53,800

your laser or look and use a different

197

00:07:56,969 --> 00:07:55,330

floor for or if you're looking for

198

00:07:59,699 --> 00:07:56,979

different molecules you can easily just

199

00:08:01,529 --> 00:07:59,709

take this out switch the components and

200

00:08:03,420 --> 00:08:01,539

put it back in and then you're done so

201  
00:08:06,350 --> 00:08:03,430  
this is a very it's a good design

202  
00:08:11,040 --> 00:08:06,360  
consideration when when building modular

203  
00:08:12,659 --> 00:08:11,050  
systems in lab so this is the optical

204  
00:08:13,829 --> 00:08:12,669  
system so this is what this is what it

205  
00:08:15,600 --> 00:08:13,839  
looks like when you just look for

206  
00:08:17,579 --> 00:08:15,610  
components online and you put them

207  
00:08:18,899 --> 00:08:17,589  
together in a CAD model what does it

208  
00:08:20,429 --> 00:08:18,909  
look like in real life when you actually

209  
00:08:22,489 --> 00:08:20,439  
get these components and put it together

210  
00:08:26,339 --> 00:08:22,499  
it looks like this it's the same thing

211  
00:08:28,109 --> 00:08:26,349  
which you know for me was not that easy

212  
00:08:30,389 --> 00:08:28,119  
because a lot of times when you get

213  
00:08:32,159 --> 00:08:30,399

these components they don't work or they

214

00:08:33,870 --> 00:08:32,169

don't fit together right so you have to

215

00:08:35,969 --> 00:08:33,880

kind of pick and play and pick and

216

00:08:37,019 --> 00:08:35,979

choose and make sure and actually

217

00:08:39,089 --> 00:08:37,029

finalize and get into work and I'm

218

00:08:39,629 --> 00:08:39,099

pretty sure and Karen McKee here can

219

00:08:41,159 --> 00:08:39,639

relate to that

220

00:08:43,649 --> 00:08:41,169

you just had to deal with all these

221

00:08:44,610 --> 00:08:43,659

systems before but so this is what ends

222

00:08:46,769 --> 00:08:44,620

up looking like this is the final

223

00:08:49,769 --> 00:08:46,779

product it's working and I get to

224

00:08:54,120 --> 00:08:49,779

present you rope it so the title was

225

00:08:54,420 --> 00:08:54,130

rope analogues and I had a few different

226

00:08:57,510 --> 00:08:54,430

expect

227

00:08:59,910 --> 00:08:57,520

it's to do for this one but this

228

00:09:01,230 --> 00:08:59,920

specific system is using micro device

229

00:09:03,389 --> 00:09:01,240

that we designed it doesn't have

230

00:09:05,280 --> 00:09:03,399

automation which is as I mentioned

231

00:09:08,370 --> 00:09:05,290

before a critical aspect to future

232

00:09:10,380 --> 00:09:08,380

mission selections by NASA I'm just

233

00:09:13,320 --> 00:09:10,390

using a straight channel separations

234

00:09:15,960 --> 00:09:13,330

technique it's micro capillary

235

00:09:18,720 --> 00:09:15,970

electrophoresis and all it is is it

236

00:09:20,370 --> 00:09:18,730

induces a current in your capillary

237

00:09:22,560 --> 00:09:20,380

channel to generate an electro osmotic

238

00:09:24,449 --> 00:09:22,570

flow based on the stacking of your

239

00:09:26,310 --> 00:09:24,459

channel and it will move analytes down

240

00:09:30,170 --> 00:09:26,320

your channel toward your detector so you

241

00:09:32,220 --> 00:09:30,180

can select for them and identify them

242

00:09:34,170 --> 00:09:32,230

Schiphol for that really everyone got

243

00:09:36,420 --> 00:09:34,180

that but essentially you get you have an

244

00:09:38,130 --> 00:09:36,430

injection and then you change your

245

00:09:39,530 --> 00:09:38,140

currents to send your analytes down your

246

00:09:42,570 --> 00:09:39,540

detector

247

00:09:45,570 --> 00:09:42,580

simply stated what we're looking for so

248

00:09:48,329 --> 00:09:45,580

we're doing a little more simple design

249

00:09:52,470 --> 00:09:48,339

here we're looking at just amines and

250

00:09:54,750 --> 00:09:52,480

amino acids and for this we use pacific

251

00:09:56,960 --> 00:09:54,760

blue dye it's very well established for

252

00:09:59,850 --> 00:09:56,970

these types of these types of reactions

253

00:10:03,630 --> 00:09:59,860

so i'm using it because it's easy and

254

00:10:05,250 --> 00:10:03,640

it's in a 35 minute buffer at pH 9 and

255

00:10:06,990 --> 00:10:05,260

this is critical because the reaction

256

00:10:09,390 --> 00:10:07,000

will not go if the pH is too low and

257

00:10:11,340 --> 00:10:09,400

that's why I'm testing these sorts of

258

00:10:14,340 --> 00:10:11,350

sorts of analogs because as I said on

259

00:10:16,829 --> 00:10:14,350

Europa we're seeing these sulfuric acid

260

00:10:19,079 --> 00:10:16,839

basically sulfuric acid on their surface

261

00:10:21,810 --> 00:10:19,089

and these magnesium salts which can pose

262

00:10:23,160 --> 00:10:21,820

challenges to running your reactions if

263

00:10:24,930 --> 00:10:23,170

you're not in a buffered system so it's

264

00:10:27,660 --> 00:10:24,940

very important that you I didn't you

265

00:10:31,350 --> 00:10:27,670

optimize your reaction before sending

266

00:10:33,329 --> 00:10:31,360

everything out there so first I had to

267

00:10:35,160 --> 00:10:33,339

do a limiter detection of certain

268

00:10:37,769 --> 00:10:35,170

molecules just to confirm that my system

269

00:10:39,600 --> 00:10:37,779

was working and as you can see here you

270

00:10:42,360 --> 00:10:39,610

get an electropherogram so it's a

271

00:10:44,699 --> 00:10:42,370

fluorescent signal versus time so like I

272

00:10:46,620 --> 00:10:44,709

said as you're you do your injection and

273

00:10:48,360 --> 00:10:46,630

then as your your analyte goes down your

274

00:10:49,800 --> 00:10:48,370

detector you get a peak and then it

275

00:10:52,079 --> 00:10:49,810

drops back down you another peak and

276

00:10:54,569 --> 00:10:52,089

drops back down and we can identify this

277

00:10:56,160 --> 00:10:54,579

the Peaks based on standards and for

278

00:10:59,370 --> 00:10:56,170

here I have alanine and glycine so two

279

00:11:00,720 --> 00:10:59,380

basic amino acids going down the Tector

280

00:11:02,370 --> 00:11:00,730

going down your channel hitting the

281

00:11:07,040 --> 00:11:02,380

detector and then we have our pacific

282

00:11:08,580 --> 00:11:07,050

blue Peaks as our selectors for

283

00:11:10,950 --> 00:11:08,590

normalizing the

284

00:11:13,710 --> 00:11:10,960

to electropherograms and what I ended up

285

00:11:15,720 --> 00:11:13,720

finding is that the LOD for my system is

286

00:11:17,700 --> 00:11:15,730

falling within the range of previously

287

00:11:21,360 --> 00:11:17,710

built and constructed system modular

288

00:11:22,650 --> 00:11:21,370

systems in lab that are some of our

289

00:11:26,040 --> 00:11:22,660

collaborators have constructed in the

290

00:11:29,100 --> 00:11:26,050

past so I went ahead and ran some of

291

00:11:30,540 --> 00:11:29,110

these analog samples started first with

292

00:11:31,470 --> 00:11:30,550

sulfuric acid sample because I figure

293

00:11:33,480 --> 00:11:31,480

that's probably going to be one of the

294

00:11:36,680 --> 00:11:33,490

harder ones at least before I get to

295

00:11:40,590 --> 00:11:36,690

magnesium and what I end up seeing is I

296

00:11:43,710 --> 00:11:40,600

was right and it takes a lot of

297

00:11:46,350 --> 00:11:43,720

delusions and or before you can actually

298

00:11:47,940 --> 00:11:46,360

get a good separation so you know this

299

00:11:50,850 --> 00:11:47,950

is a terrible terrible terrible terrible

300

00:11:53,610 --> 00:11:50,860

and then finally after ten rounds of

301  
00:11:57,000 --> 00:11:53,620  
dilution I see I finally see a peak this

302  
00:11:58,470 --> 00:11:57,010  
is expected because the software gasset

303  
00:12:01,440 --> 00:11:58,480  
is lowering the pH of the reaction so

304  
00:12:03,900 --> 00:12:01,450  
I'm not actually getting a reaction but

305  
00:12:06,060 --> 00:12:03,910  
one thing I can do before that is just

306  
00:12:07,800 --> 00:12:06,070  
keep diluting it and diluting it and

307  
00:12:09,240 --> 00:12:07,810  
diluting it before reaction and then

308  
00:12:12,780 --> 00:12:09,250  
eventually I'll start seeing more and

309  
00:12:15,360 --> 00:12:12,790  
more Peaks over time and really that's

310  
00:12:17,550 --> 00:12:15,370  
all we want to see here is Peaks which

311  
00:12:20,580 --> 00:12:17,560  
identify organic molecules in our

312  
00:12:23,010 --> 00:12:20,590  
mixture do the same thing for carbonic

313  
00:12:25,830 --> 00:12:23,020

acid solution this is a weaker acid so

314

00:12:27,600 --> 00:12:25,840

everything went perfectly well and there

315

00:12:30,180 --> 00:12:27,610

are no problems all the peaks showed up

316

00:12:33,420 --> 00:12:30,190

and specifically could identify valine

317

00:12:34,770 --> 00:12:33,430

serine Ali and glycine you can do as

318

00:12:36,450 --> 00:12:34,780

many as you want you can select for

319

00:12:38,730 --> 00:12:36,460

whatever organic molecules these ones

320

00:12:43,140 --> 00:12:38,740

are just really easy standards to use

321

00:12:47,040 --> 00:12:43,150

for a model system one important thing

322

00:12:52,050 --> 00:12:47,050

to note is the signal-to-noise ratio of

323

00:12:54,390 --> 00:12:52,060

your mixtures at the ends you could kind

324

00:12:56,010 --> 00:12:54,400

of see I had quantified before what

325

00:12:58,110 --> 00:12:56,020

happens over time when you start doing

326

00:13:01,200 --> 00:12:58,120

dilutions your signal goes up and then

327

00:13:02,640 --> 00:13:01,210

levels out really all you want to do is

328

00:13:06,960 --> 00:13:02,650

get to the point where your signal goes

329

00:13:09,090 --> 00:13:06,970

up because you're essentially any

330

00:13:11,190 --> 00:13:09,100

dilution an ideal dilution is not

331

00:13:12,630 --> 00:13:11,200

necessary because any signal is good

332

00:13:14,580 --> 00:13:12,640

signal when you're looking for signs of

333

00:13:17,520 --> 00:13:14,590

life somewhere in the out words in the

334

00:13:19,830 --> 00:13:17,530

other solar system so once we get that

335

00:13:21,970 --> 00:13:19,840

signal we just inject our standards into

336

00:13:23,860 --> 00:13:21,980

it quantify it and we know it's there

337

00:13:25,090 --> 00:13:23,870

and I don't want to I will say any

338

00:13:27,310 --> 00:13:25,100

signal is good to know I'll leave a

339

00:13:29,200 --> 00:13:27,320

caveat to that as long as you can show

340

00:13:30,850 --> 00:13:29,210

it reproducibly because you don't want

341

00:13:32,980 --> 00:13:30,860

to get into the situation where you show

342

00:13:35,770 --> 00:13:32,990

one result but can never show it again

343

00:13:37,090 --> 00:13:35,780

who can create some very fishy scenarios

344

00:13:38,590 --> 00:13:37,100

in the scientific community so you got

345

00:13:42,160 --> 00:13:38,600

to make sure that you can actually prove

346

00:13:43,990 --> 00:13:42,170

your data we have so some of the

347

00:13:46,240 --> 00:13:44,000

accomplishments in future directions I

348

00:13:48,460 --> 00:13:46,250

show that the system is working and that

349

00:13:51,970 --> 00:13:48,470

these some of the early analogs that

350

00:13:56,380 --> 00:13:51,980

we're testing are showing us promise for

351  
00:13:58,540 --> 00:13:56,390  
future experiments and future

352  
00:14:03,280 --> 00:13:58,550  
experiments like using magnesium salts

353  
00:14:04,480 --> 00:14:03,290  
and perchlorates that's the magnesium

354  
00:14:06,460 --> 00:14:04,490  
salts are going to be a little more of a

355  
00:14:09,070 --> 00:14:06,470  
challenge because they will one one

356  
00:14:09,460 --> 00:14:09,080  
critical aspects about using doing micro

357  
00:14:11,560 --> 00:14:09,470  
seee

358  
00:14:14,530 --> 00:14:11,570  
is electro osmotic flow and you need a

359  
00:14:17,110 --> 00:14:14,540  
flow for your detector in order to

360  
00:14:19,990 --> 00:14:17,120  
actually get a separation we have some

361  
00:14:22,180 --> 00:14:20,000  
more future projects going on one is

362  
00:14:23,620 --> 00:14:22,190  
automating our device another one is ice

363  
00:14:26,710 --> 00:14:23,630

impact particles so we have other

364

00:14:28,450 --> 00:14:26,720

collaborators doing research in which

365

00:14:30,670 --> 00:14:28,460

we're impacting ice particles into a

366

00:14:33,010 --> 00:14:30,680

foil disc to simulate a plume extraction

367

00:14:35,410 --> 00:14:33,020

and then we have miniaturized optics

368

00:14:37,180 --> 00:14:35,420

which we're testing I don't like to