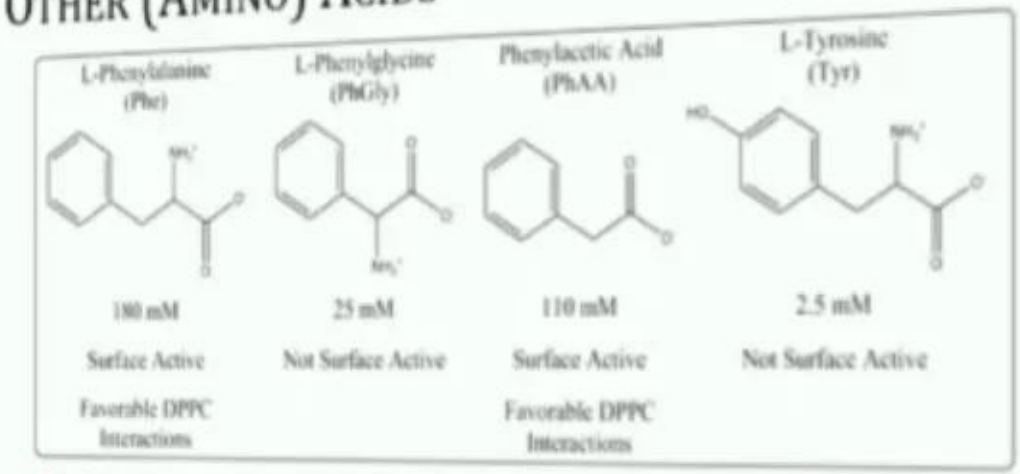
Other (Amino) Acids



Perkins, R. J. *et al. J. Phys. Chem. B* (2016). doi:10.1021/acs.jpcb.6b05084

- Not easy to predict how amino acids will interact with membranes.
- In this series, interactions seem to be governed by clustering of molecules inside the membrane.
- Bonus! Molecules tend to cluster/aggregate better if they share chirality.[1]

1) Singh, V., Rai, R. K., Arora, A., Sinha, N. & Thakur, A. K. *Scientific Reports* **4**, 3875 (2014).

1
00:00:12,410 --> 00:00:09,530
talk a little bit about evolution and

2
00:00:15,680 --> 00:00:12,420
membranes and amino acids and hopefully

3
00:00:18,170 --> 00:00:15,690
you'll get something out of it so I'm

4
00:00:20,210 --> 00:00:18,180
kind of looking at the origin of life

5
00:00:22,340 --> 00:00:20,220
from an evolutionary perspective and so

6
00:00:24,380 --> 00:00:22,350
we know a little bit about what life

7
00:00:25,910 --> 00:00:24,390
looks like today we know a little bit

8
00:00:29,120 --> 00:00:25,920
about what the earth would have looked

9
00:00:30,769 --> 00:00:29,130
like you know before life existed and so

10
00:00:33,470 --> 00:00:30,779
we're kind of interested in how we get

11
00:00:35,299 --> 00:00:33,480
from one to the other and so that kind

12
00:00:37,490 --> 00:00:35,309
of guiding principle that we're going to

13
00:00:40,100 --> 00:00:37,500

use and take advantage of that a lot of

14
00:00:43,130 --> 00:00:40,110
people here are doing as well is natural

15
00:00:45,260 --> 00:00:43,140
selection which stated in a very simple

16
00:00:49,549 --> 00:00:45,270
way is that things that happen to work

17
00:00:51,080 --> 00:00:49,559
are more likely to stick around and so

18
00:00:52,369 --> 00:00:51,090
I'm going to focus on proteins a fair

19
00:00:55,400 --> 00:00:52,379
amount because there's something that's

20
00:00:57,529 --> 00:00:55,410
very important to life as we know it so

21
00:01:00,590 --> 00:00:57,539
you know about twenty percent of you is

22
00:01:02,330 --> 00:01:00,600
made of protein and they're one that's

23
00:01:03,650 --> 00:01:02,340
very problematic from an origin of life

24
00:01:06,200 --> 00:01:03,660
perspective because they're very

25
00:01:08,120 --> 00:01:06,210
difficult to make the way that modern

26
00:01:10,370 --> 00:01:08,130
proteins are synthesized uses enzymes

27
00:01:11,719 --> 00:01:10,380
which are already made of protein so you

28
00:01:14,600 --> 00:01:11,729
have kind of a chicken and egg problem

29
00:01:17,780 --> 00:01:14,610
to begin with and some sort of

30
00:01:19,280 --> 00:01:17,790
informational polymer to you know figure

31
00:01:22,219 --> 00:01:19,290
out how you want to stick your proteins

32
00:01:24,140 --> 00:01:22,229
together but there are other problems

33
00:01:26,570 --> 00:01:24,150
too so even if you have a really good

34
00:01:28,280 --> 00:01:26,580
assembly mechanisms if amino acids

35
00:01:31,580 --> 00:01:28,290
wanted to just spontaneously stick

36
00:01:33,050 --> 00:01:31,590
together you know you still need to have

37
00:01:34,520 --> 00:01:33,060
them around and reasonably high

38
00:01:36,020 --> 00:01:34,530

quantities which is something that I'm

39
00:01:40,789 --> 00:01:36,030
not going to address too much directly

40
00:01:42,260 --> 00:01:40,799
today you know it's not that evolution

41
00:01:43,910 --> 00:01:42,270
would ever be like hey if we had amino

42
00:01:45,889 --> 00:01:43,920
acids we could make these proteins which

43
00:01:48,260 --> 00:01:45,899
would be super useful so we'll make

44
00:01:52,460 --> 00:01:48,270
amino acids it's not how it works it

45
00:01:54,980 --> 00:01:52,470
uses things that are already around and

46
00:01:57,410 --> 00:01:54,990
so kind of defining life is a little bit

47
00:02:01,249 --> 00:01:57,420
tricky especially you know at what point

48
00:02:02,749 --> 00:02:01,259
you move from non-life to life and so

49
00:02:06,410 --> 00:02:02,759
the kind of characteristic that I'm

50
00:02:08,059 --> 00:02:06,420
gonna going to focus on is that life is

51
00:02:11,270 --> 00:02:08,069
out of equilibrium it's different from

52
00:02:14,050 --> 00:02:11,280
its surroundings and so generally it

53
00:02:17,360 --> 00:02:14,060
uses some sort of energy source to

54
00:02:19,820 --> 00:02:17,370
increase organization and order and so

55
00:02:21,410 --> 00:02:19,830
kind of with this in mind a couple

56
00:02:23,440 --> 00:02:21,420
things that we really want or some sort

57
00:02:25,880 --> 00:02:23,450
of metabolism to make useful molecules

58
00:02:29,030 --> 00:02:25,890
and some sort of enclosure to keep your

59
00:02:31,009 --> 00:02:29,040
useful molecules together right so it's

60
00:02:32,839 --> 00:02:31,019
not enough just having all the pieces

61
00:02:35,059 --> 00:02:32,849
like if you dissolve a human and a

62
00:02:38,449 --> 00:02:35,069
bathtub it's no longer alive even though

63
00:02:40,539 --> 00:02:38,459

all the molecules are still there so I

64
00:02:42,380 --> 00:02:40,549
think this is a very important component

65
00:02:44,059 --> 00:02:42,390
and then you want some sort of

66
00:02:45,229 --> 00:02:44,069
robustness and replication you want

67
00:02:48,069 --> 00:02:45,239
something to stick around for long

68
00:02:50,210 --> 00:02:48,079
enough that it can make more of itself

69
00:02:51,589 --> 00:02:50,220
but i'm not going to focus on that too

70
00:02:54,440 --> 00:02:51,599
much today i'm really going to focus on

71
00:02:57,160 --> 00:02:54,450
kind of the enclosures aspect in

72
00:03:01,099 --> 00:02:57,170
addition to the amino acids and proteins

73
00:03:03,259 --> 00:03:01,109
and so we know a couple things about you

74
00:03:05,300 --> 00:03:03,269
know prebiotic membranes we have some

75
00:03:08,059 --> 00:03:05,310
plausible ones at least that could have

76
00:03:10,789 --> 00:03:08,069
existed and these are mainly kind of

77
00:03:12,619 --> 00:03:10,799
fatty acids fatty acid vesicles but they

78
00:03:14,449 --> 00:03:12,629
have some problems we know that they're

79
00:03:17,300 --> 00:03:14,459
not perfect for you know primitive

80
00:03:19,069 --> 00:03:17,310
enclosures and they're kind of biggest

81
00:03:21,140 --> 00:03:19,079
problem is that you need really high

82
00:03:23,240 --> 00:03:21,150
fatty acid concentrations in order to

83
00:03:25,490 --> 00:03:23,250
get these things to form and to stay

84
00:03:27,470 --> 00:03:25,500
formed so even if you make a vesicle out

85
00:03:29,509 --> 00:03:27,480
of fatty acids if you move it to a place

86
00:03:31,309 --> 00:03:29,519
where there's low kind of dissolved

87
00:03:34,039 --> 00:03:31,319
fatty acid concentration it falls apart

88
00:03:35,869 --> 00:03:34,049

you know and then it they're generally

89
00:03:39,500 --> 00:03:35,879
incompatible with divalent salts which

90
00:03:42,439 --> 00:03:39,510
we probably had around too and I think

91
00:03:44,809 --> 00:03:42,449
one of the things that is a really good

92
00:03:47,240 --> 00:03:44,819
idea and Roy black has really been kind

93
00:03:49,339 --> 00:03:47,250
of champion the champion this idea is

94
00:03:50,689 --> 00:03:49,349
that inclusions and the vesicles can

95
00:03:53,360 --> 00:03:50,699
change their properties and very

96
00:03:56,509 --> 00:03:53,370
dramatic ways and might be very helpful

97
00:04:00,039 --> 00:03:56,519
for getting something that is prebiotic

98
00:04:04,000 --> 00:04:00,049
irrelevant and would actually work and

99
00:04:07,009 --> 00:04:04,010
so I'm going to look a little bit how

100
00:04:10,000 --> 00:04:07,019
membranes systems exist in modern life

101
00:04:11,629 --> 00:04:10,010
and so they're largely made of

102
00:04:13,939 --> 00:04:11,639
surfactants it's one of the main

103
00:04:15,530 --> 00:04:13,949
components and they're generally you

104
00:04:17,000 --> 00:04:15,540
know in very simple terms molecules that

105
00:04:18,289 --> 00:04:17,010
have one side that likes interacting

106
00:04:20,390 --> 00:04:18,299
with water in one side that really

107
00:04:25,010 --> 00:04:20,400
doesn't and so they kind of form these

108
00:04:26,360 --> 00:04:25,020
by layered membranes that separate you

109
00:04:26,940 --> 00:04:26,370
know the outside of yourself from the

110
00:04:29,990 --> 00:04:26,950
inside

111
00:04:32,280 --> 00:04:30,000
keeps on things out keep some things in

112
00:04:35,190 --> 00:04:32,290
but that's not the only thing that is

113
00:04:37,680 --> 00:04:35,200

you know in our modern membranes there's

114
00:04:39,240 --> 00:04:37,690
a lot of proteins and these proteins

115
00:04:43,110 --> 00:04:39,250
perform a lot of very important

116
00:04:46,080 --> 00:04:43,120
functions you know to life and so you

117
00:04:48,420 --> 00:04:46,090
know they keep everything structured the

118
00:04:52,050 --> 00:04:48,430
control transport of material inside and

119
00:04:53,850 --> 00:04:52,060
out of cells you know they have a pretty

120
00:04:55,980 --> 00:04:53,860
large role in signaling whether it's

121
00:04:58,910 --> 00:04:55,990
getting a cell to swim around or getting

122
00:05:01,260 --> 00:04:58,920
me to stand up here and talk at you and

123
00:05:02,850 --> 00:05:01,270
maybe surprisingly to a lot of people

124
00:05:05,010 --> 00:05:02,860
they have a really big role in energy

125
00:05:06,740 --> 00:05:05,020
metabolism so a lot of the proteins that

126
00:05:09,060 --> 00:05:06,750
are involved in photosynthesis and

127
00:05:14,130 --> 00:05:09,070
oxidative phosphorylation and actually

128
00:05:15,990 --> 00:05:14,140
membrane proteins and so looking back at

129
00:05:19,160 --> 00:05:16,000
the relationship between amino acids and

130
00:05:22,800 --> 00:05:19,170
proteins kind of the local amino acid

131
00:05:25,230 --> 00:05:22,810
composition of a protein controls its

132
00:05:27,570 --> 00:05:25,240
function and a lot of ways and so a very

133
00:05:30,240 --> 00:05:27,580
simple example of this is you know just

134
00:05:33,450 --> 00:05:30,250
a membrane protein I have a channel type

135
00:05:35,250 --> 00:05:33,460
thing drawn here very crudely you

136
00:05:38,460 --> 00:05:35,260
generally have these kind of hydrophobic

137
00:05:42,020 --> 00:05:38,470
amino acids in spots worth interacting

138
00:05:44,940 --> 00:05:42,030

with the kind of hydrophobic part of the

139
00:05:46,620 --> 00:05:44,950
membrane and so it's kind of stable in

140
00:05:48,510 --> 00:05:46,630
the membrane and wants to stay there and

141
00:05:52,650 --> 00:05:48,520
then you have this hydrophilic stuff

142
00:05:54,900 --> 00:05:52,660
that forms your channel and so I think

143
00:05:57,630 --> 00:05:54,910
an important question to ask is do you

144
00:05:59,490 --> 00:05:57,640
actually need or you know can the amino

145
00:06:01,440 --> 00:05:59,500
acids perform some of the roles that

146
00:06:05,550 --> 00:06:01,450
proteins do today without being

147
00:06:07,500 --> 00:06:05,560
assembled into proteins and so some of

148
00:06:10,140 --> 00:06:07,510
the techniques that I use to investigate

149
00:06:12,390 --> 00:06:10,150
kind of similar questions are surface

150
00:06:15,000 --> 00:06:12,400
surface sensitive technique so I'll look

151
00:06:17,160 --> 00:06:15,010
at a single mono layer of surfactant on

152
00:06:19,620 --> 00:06:17,170
the water surface this is nice because

153
00:06:22,380 --> 00:06:19,630
it's a very controlled system even if

154
00:06:24,270 --> 00:06:22,390
it's a little less relevant so you get

155
00:06:26,100 --> 00:06:24,280
to kind of scrape these barriers across

156
00:06:28,050 --> 00:06:26,110
the water surface and you can control

157
00:06:30,690 --> 00:06:28,060
the you know relative surface

158
00:06:33,120 --> 00:06:30,700
concentration of your surfactants and

159
00:06:34,650 --> 00:06:33,130
you get thermodynamic information by

160
00:06:36,020 --> 00:06:34,660
measuring surface tension as you change

161
00:06:38,120 --> 00:06:36,030
the surface concentration

162
00:06:39,830 --> 00:06:38,130
you can use this in conjunction with

163
00:06:42,740 --> 00:06:39,840

other techniques like Brewster angle

164
00:06:45,080 --> 00:06:42,750
microscopy which is really neat because

165
00:06:47,660 --> 00:06:45,090
you get to you know basically take

166
00:06:51,440 --> 00:06:47,670
pictures of single molecule thick films

167
00:06:56,360 --> 00:06:51,450
at water surfaces and so kind of an

168
00:06:58,910 --> 00:06:56,370
example of some of the interactions

169
00:07:02,090 --> 00:06:58,920
between you know a membrane type system

170
00:07:03,800 --> 00:07:02,100
and a you know amino acid it's not the

171
00:07:05,510 --> 00:07:03,810
most prebiotic irrelevant I don't think

172
00:07:08,180 --> 00:07:05,520
people thought phenylalanine was around

173
00:07:10,460 --> 00:07:08,190
prebiotic Lee and dvb-c certainly was

174
00:07:15,020 --> 00:07:10,470
not it's a big complex molecule that all

175
00:07:17,030 --> 00:07:15,030
of you are full of but at any rate I

176
00:07:19,130 --> 00:07:17,040
think it's a good example of kind of a

177
00:07:21,110 --> 00:07:19,140
very strong perturbation by an inclusion

178
00:07:23,750 --> 00:07:21,120
into a membrane and so phenylalanine

179
00:07:27,110 --> 00:07:23,760
incorporates into this mono layer of

180
00:07:28,520 --> 00:07:27,120
dppc and you know right away between

181
00:07:30,320 --> 00:07:28,530
these two brewster angle microscopy

182
00:07:33,350 --> 00:07:30,330
pictures you can see there's a huge

183
00:07:35,150 --> 00:07:33,360
change in morphology it has kind of a

184
00:07:38,750 --> 00:07:35,160
condensing effect on some regions of the

185
00:07:40,790 --> 00:07:38,760
film and you know alters the stability

186
00:07:47,240 --> 00:07:40,800
by by interacting with dppc in

187
00:07:48,740 --> 00:07:47,250
favourable ways and you know kind of an

188
00:07:51,410 --> 00:07:48,750

interesting point about all of this is

189
00:07:52,910 --> 00:07:51,420
that different amino acids behave very

190
00:07:55,820 --> 00:07:52,920
differently even if they look very

191
00:07:58,100 --> 00:07:55,830
similar so it's not always going to be

192
00:08:00,350 --> 00:07:58,110
easy to predict how things are going to

193
00:08:01,700 --> 00:08:00,360
behave so up here I just have like the

194
00:08:04,010 --> 00:08:01,710
solubilities of these different

195
00:08:07,970 --> 00:08:04,020
compounds and they're all across the

196
00:08:09,440 --> 00:08:07,980
board and it actually turns out the key

197
00:08:11,930 --> 00:08:09,450
to understanding the differences in this

198
00:08:15,530 --> 00:08:11,940
system is the clustering of these amino

199
00:08:16,940 --> 00:08:15,540
acids so these two like to cluster with

200
00:08:18,590 --> 00:08:16,950
themselves once they're inside the

201
00:08:20,900 --> 00:08:18,600
membrane they don't cluster in solution

202
00:08:23,150 --> 00:08:20,910
but in the membrane they do and this

203
00:08:25,670 --> 00:08:23,160
really controls their kind of membrane

204
00:08:27,110 --> 00:08:25,680
altering behavior and I don't know how

205
00:08:29,180 --> 00:08:27,120
general this is but I think it's a

206
00:08:31,970 --> 00:08:29,190
really neat effect particularly because

207
00:08:33,740 --> 00:08:31,980
if you have you know aggregation a lot

208
00:08:35,270 --> 00:08:33,750
of the times that's chirality dependent

209
00:08:37,070 --> 00:08:35,280
and so it gives you something that you

210
00:08:43,580 --> 00:08:37,080
know it's potentially selective for

211
00:08:45,110 --> 00:08:43,590
chirality and so

212
00:08:47,810 --> 00:08:45,120
you know I didn't talk about the most

213
00:08:52,040 --> 00:08:47,820

prebiotic irrelevant system but I think

214
00:08:53,990 --> 00:08:52,050
that it's important for illustrating a

215
00:08:57,440 --> 00:08:54,000
point and then you know that the other

216
00:08:59,150 --> 00:08:57,450
issue is that the types of membrane

217
00:09:01,430 --> 00:08:59,160
alterations that you want by your

218
00:09:04,280 --> 00:09:01,440
specific inclusions are going to vary

219
00:09:06,020 --> 00:09:04,290
dramatically based on the composition of

220
00:09:07,790 --> 00:09:06,030
whatever you know type of membrane

221
00:09:09,680 --> 00:09:07,800
you're talking about so if you have

222
00:09:11,420 --> 00:09:09,690
something that's like a fatty acid

223
00:09:15,500 --> 00:09:11,430
membrane that's already very permeable

224
00:09:18,130 --> 00:09:15,510
but it's you know not very stable you're

225
00:09:20,180 --> 00:09:18,140
probably going to preferentially select

226
00:09:22,250 --> 00:09:20,190
inclusions that are increased going to

227
00:09:24,530 --> 00:09:22,260
increase the stability but if you have a

228
00:09:27,020 --> 00:09:24,540
different type of membrane you know like

229
00:09:29,540 --> 00:09:27,030
modern phospholipid membranes are very

230
00:09:31,340 --> 00:09:29,550
stable but they're not permeable and so

231
00:09:32,900 --> 00:09:31,350
you're you know those types of membrane

232
00:09:34,070 --> 00:09:32,910
systems you're going to select for

233
00:09:37,070 --> 00:09:34,080
things that are going to increase

234
00:09:39,200 --> 00:09:37,080
permeability so you have to remember

235
00:09:41,060 --> 00:09:39,210
that when you're looking for inclusions

236
00:09:43,010 --> 00:09:41,070
to perturb something that depends what

237
00:09:45,670 --> 00:09:43,020
properties your your initial thing has

238
00:09:48,320 --> 00:09:45,680

you know then the other point is that

239
00:09:50,150 --> 00:09:48,330
for any prebiotic scenario we're not

240
00:09:52,310 --> 00:09:50,160
going to have you know a single isolated

241
00:09:54,470 --> 00:09:52,320
compound or a mixture of two it's going

242
00:09:57,500 --> 00:09:54,480
to be something that's much more complex

243
00:09:59,330 --> 00:09:57,510
and it's going to have its own set of

244
00:10:01,580 --> 00:09:59,340
criteria so it's something that's very

245
00:10:04,910 --> 00:10:01,590
hard to investigate but I think worth

246
00:10:06,920 --> 00:10:04,920
doing and you know kind of likewise

247
00:10:09,530 --> 00:10:06,930
having a variety of amino acids is going

248
00:10:11,600 --> 00:10:09,540
to let you kind of selectively modify

249
00:10:14,230 --> 00:10:11,610
different characteristics depending on

250
00:10:17,270 --> 00:10:14,240
which amino acids want to incorporate

251
00:10:18,560 --> 00:10:17,280
and then kind of the final point that I

252
00:10:21,320 --> 00:10:18,570
wanted to make is that I think that

253
00:10:23,840 --> 00:10:21,330
membrane systems are very promising for

254
00:10:27,290 --> 00:10:23,850
as far as making the transition from

255
00:10:29,390 --> 00:10:27,300
amino acids to proteins just because the

256
00:10:31,880 --> 00:10:29,400
amino acids kind of have a role to play

257
00:10:34,250 --> 00:10:31,890
in the first place but also because you

258
00:10:36,710 --> 00:10:34,260
have a couple of advantages so if you

259
00:10:38,330 --> 00:10:36,720
are getting something that's kind of

260
00:10:40,820 --> 00:10:38,340
intercalating into a membrane in the

261
00:10:42,380 --> 00:10:40,830
first place you're inherently increasing

262
00:10:43,880 --> 00:10:42,390
the concentration you're moving from a

263
00:10:47,870 --> 00:10:43,890

three-dimensional space into a

264
00:10:50,480 --> 00:10:47,880
two-dimensional one you know the

265
00:10:52,490 --> 00:10:50,490
clustering allows the organization like

266
00:10:54,230 --> 00:10:52,500
I said before and potentially is chiral

267
00:10:57,590 --> 00:10:54,240
e selective which is another interesting

268
00:10:59,720 --> 00:10:57,600
topic and it's also a very

269
00:11:01,730 --> 00:10:59,730
chemical environment so normally making

270
00:11:04,069 --> 00:11:01,740
peptide bonds is unfavorable in water

271
00:11:06,790 --> 00:11:04,079
and so the membrane is kind of a

272
00:11:10,340 --> 00:11:06,800
hydrophobic environment that might help

273
00:11:12,259 --> 00:11:10,350
we've actually seen that water

274
00:11:16,189 --> 00:11:12,269
interfaces can be favorable for amino

275
00:11:18,230 --> 00:11:16,199
acid or for peptide bond formation in

276
00:11:19,610 --> 00:11:18,240
the past but I think the most

277
00:11:21,800 --> 00:11:19,620
interesting part of this is that it

278
00:11:23,710 --> 00:11:21,810
doesn't necessarily acquire any sort of

279
00:11:26,290 --> 00:11:23,720
informational polymer to assemble

280
00:11:28,129 --> 00:11:26,300
because you're already kind of

281
00:11:30,499 --> 00:11:28,139
intercalating into the membrane and

282
00:11:32,840 --> 00:11:30,509
clustering in a way that's useful and so

283
00:11:37,249 --> 00:11:32,850
that's kind of your selection for making

284
00:11:40,790 --> 00:11:37,259
a useful protein in the first place huh

285
00:11:43,280 --> 00:11:40,800
and so with that I'd like to acknowledge

286
00:11:44,900 --> 00:11:43,290
my group and some of that collaborators

287
00:11:46,340 --> 00:11:44,910
that I've worked with in a little bit of

288
00:12:01,749 --> 00:11:46,350

the research that I showed and a little

289
00:12:06,530 --> 00:12:04,850
have you experimented with the different

290
00:12:08,600 --> 00:12:06,540
amino acids for membrane stability

291
00:12:11,749 --> 00:12:08,610
because you pointed out the theoretical

292
00:12:13,490 --> 00:12:11,759
stability so building upon that work

293
00:12:15,439 --> 00:12:13,500
because you have a whole suite to work

294
00:12:17,689 --> 00:12:15,449
from yeah it's kind of an interesting

295
00:12:21,079 --> 00:12:17,699
thing because in a lot of ways it

296
00:12:25,129 --> 00:12:21,089
depends what you what type of stability

297
00:12:26,600 --> 00:12:25,139
you want so you know really I should

298
00:12:29,019 --> 00:12:26,610
probably move to be moving a little bit

299
00:12:31,280 --> 00:12:29,029
more than the vesicle type of systems

300
00:12:33,889 --> 00:12:31,290
where you can see what it takes to make

301
00:12:39,410 --> 00:12:33,899
your vesicle fall apart resistance to

302
00:12:41,900 --> 00:12:39,420
assault and things like that stability

303
00:12:43,370 --> 00:12:41,910
is kind of confusing for looking between

304
00:12:45,319 --> 00:12:43,380
two dimensional and kind of three

305
00:12:47,509 --> 00:12:45,329
dimensional vesicle systems do you think

306
00:12:49,639 --> 00:12:47,519
some would actually provide divest

307
00:12:52,670 --> 00:12:49,649
ability to divalent cations which is a

308
00:12:53,870 --> 00:12:52,680
great problem with fatty acids I think

309
00:12:55,699 --> 00:12:53,880
that there is almost definitely

310
00:12:57,110 --> 00:12:55,709
something that will whether it's an

311
00:13:00,019 --> 00:12:57,120
amino acid or not i think is

312
00:13:01,650 --> 00:13:00,029
questionable but the magic of

313
00:13:15,120 --> 00:13:01,660

phosphocholine right yeah

314
00:13:16,980 --> 00:13:15,130
I was just wondering it's not a amino

315
00:13:19,980 --> 00:13:16,990
acid but incorporation of cholesterol

316
00:13:21,930 --> 00:13:19,990
into the membranes yes since I tried

317
00:13:23,700 --> 00:13:21,940
that and so how that affects their

318
00:13:26,730 --> 00:13:23,710
stability cuz I know that's how cells

319
00:13:28,920 --> 00:13:26,740
regulate it now with yeah with modern

320
00:13:32,730 --> 00:13:28,930
cell membrane certainly cholesterol has

321
00:13:35,190 --> 00:13:32,740
a huge role to play I'm not sure it's

322
00:13:38,610 --> 00:13:35,200
going to be the most useful one for

323
00:13:40,650 --> 00:13:38,620
fatty acids because generally what it

324
00:13:43,050 --> 00:13:40,660
does in in kind of phospholipid type

325
00:13:45,810 --> 00:13:43,060
membranes is it makes them a little bit

326
00:13:47,400 --> 00:13:45,820
more fluid I'm kind of more permeable

327
00:13:49,590 --> 00:13:47,410
which is something that's not really an

328
00:13:51,000 --> 00:13:49,600
issue for fatty acids to begin with so

329
00:13:52,740 --> 00:13:51,010
it's it's almost like you're trying to

330
00:13:54,150 --> 00:13:52,750
fix the wrong problem if you're using a

331
00:14:02,250 --> 00:13:54,160
molecule like that fatty needs the