



**SCIENCE & THE ARTS
HOSTED BY TAHIRA ALLEN
& HEATHER GRAHAM**

1
00:00:04,870 --> 00:00:02,550
all right well good evening everyone i

2
00:00:06,710 --> 00:00:04,880
hope that you are having a blast at

3
00:00:08,790 --> 00:00:06,720
absycon this week

4
00:00:10,390 --> 00:00:08,800
thank you all for joining us on this

5
00:00:12,470 --> 00:00:10,400
wednesday evening

6
00:00:14,230 --> 00:00:12,480
my name is tahira allen and i will be

7
00:00:16,070 --> 00:00:14,240
one of your moderators tonight along

8
00:00:17,510 --> 00:00:16,080
with my fantastic colleague heather

9
00:00:19,910 --> 00:00:17,520
graham right here

10
00:00:22,269 --> 00:00:19,920
and i am a science communicator working

11
00:00:24,550 --> 00:00:22,279
as the new digital lead for nasa's

12
00:00:26,390 --> 00:00:24,560
astrobiology program and planetary

13
00:00:29,269 --> 00:00:26,400

science division

14

00:00:31,109 --> 00:00:29,279

so tonight we have an amazing panel on

15

00:00:33,270 --> 00:00:31,119

when worlds collide

16

00:00:36,470 --> 00:00:33,280

science and the arts where we will be

17

00:00:39,110 --> 00:00:36,480

discussing how art can drive our science

18

00:00:41,030 --> 00:00:39,120

and how science can drive the arts we

19

00:00:44,709 --> 00:00:41,040

will also be talking about how science

20

00:00:47,029 --> 00:00:44,719

can make its way onto a picture a play

21

00:00:49,190 --> 00:00:47,039

or even a stage

22

00:00:51,029 --> 00:00:49,200

so before we dive into panel

23

00:00:52,709 --> 00:00:51,039

introductions though i would kind of

24

00:00:54,950 --> 00:00:52,719

like to get a

25

00:00:57,830 --> 00:00:54,960

temperature of the room so

26

00:01:01,430 --> 00:00:57,840

by a show of hands who here has a

27

00:01:06,789 --> 00:01:03,510

okay very nice very nice

28

00:01:10,230 --> 00:01:06,799

so how many of you have ever used art to

29

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

convey scientific topics

30

00:01:16,310 --> 00:01:13,280

oh wow okay many people that is okay

31

00:01:19,350 --> 00:01:16,320

great so who here got into the field of

32

00:01:22,070 --> 00:01:19,360

science or maybe got inspiration from

33

00:01:24,149 --> 00:01:22,080

science fiction

34

00:01:26,149 --> 00:01:24,159

okay very nice you all came to the right

35

00:01:28,870 --> 00:01:26,159

the right show

36

00:01:31,429 --> 00:01:28,880

and then finally who here is anybody

37

00:01:32,950 --> 00:01:31,439

interested in using art to convey

38

00:01:37,030 --> 00:01:32,960

science topics

39

00:01:42,870 --> 00:01:40,390

okay okay great great great so there can

40

00:01:45,270 --> 00:01:42,880

sometimes be a notion that science and

41

00:01:48,389 --> 00:01:45,280

art don't go together so one of our big

42

00:01:51,190 --> 00:01:48,399

goals tonight is to really draw a bridge

43

00:01:53,429 --> 00:01:51,200

between these two areas and to show that

44

00:01:54,710 --> 00:01:53,439

they can have a positive influence on

45

00:01:56,870 --> 00:01:54,720

each other

46

00:01:58,389 --> 00:01:56,880

so what you can expect tonight

47

00:02:00,950 --> 00:01:58,399

heather and i will kind of kick off the

48

00:02:03,109 --> 00:02:00,960

conversation with a few questions then

49

00:02:05,190 --> 00:02:03,119

we will open up the floor for any

50

00:02:07,190 --> 00:02:05,200

questions from our audience and then we

51
00:02:08,469 --> 00:02:07,200
will end the night with a musical

52
00:02:11,029 --> 00:02:08,479
performance by

53
00:02:14,150 --> 00:02:11,039
tim griffin here on the very end

54
00:02:16,710 --> 00:02:15,350
okay great

55
00:02:18,390 --> 00:02:16,720
so

56
00:02:19,910 --> 00:02:18,400
let's get started with the panel

57
00:02:20,830 --> 00:02:19,920
introductions heather do you want to

58
00:02:24,550 --> 00:02:20,840
kick us

59
00:02:26,390 --> 00:02:24,560
off hi i'm heather graham i'm a research

60
00:02:28,630 --> 00:02:26,400
scientist at nasa goddard space flight

61
00:02:30,869 --> 00:02:28,640
center and when i'm not doing that i am

62
00:02:32,790 --> 00:02:30,879
a theater artist

63
00:02:34,710 --> 00:02:32,800

i started out before i was even a

64

00:02:36,710 --> 00:02:34,720

scientist

65

00:02:38,790 --> 00:02:36,720

doing wigs and prosthetics and

66

00:02:40,229 --> 00:02:38,800

accessories for the stage it turns out

67

00:02:41,190 --> 00:02:40,239

that doesn't pay as well as you might

68

00:02:44,869 --> 00:02:41,200

think

69

00:02:46,949 --> 00:02:44,879

and i've also written a couple of plays

70

00:02:49,509 --> 00:02:46,959

one of them very notably i was working

71

00:02:51,190 --> 00:02:49,519

on in 2014 and got to talking with

72

00:02:54,070 --> 00:02:51,200

another writer who was working on a

73

00:02:55,190 --> 00:02:54,080

similar topic that person was margo lee

74

00:02:56,070 --> 00:02:55,200

shetterly

75

00:02:58,149 --> 00:02:56,080

and

76

00:03:00,229 --> 00:02:58,159

we talked about the topics that we were

77

00:03:02,550 --> 00:03:00,239

working on and i went on to write an

78

00:03:04,470 --> 00:03:02,560

opera about a nasa mathematician and she

79

00:03:07,030 --> 00:03:04,480

wrote a book on the same topic which is

80

00:03:10,869 --> 00:03:07,040

hidden figures she obviously did a lot

81

00:03:14,949 --> 00:03:12,949

but it was such an honor to to write

82

00:03:17,670 --> 00:03:14,959

that material and get to work with so

83

00:03:20,470 --> 00:03:17,680

many excellent theater artists on that

84

00:03:23,270 --> 00:03:20,480

and i'll pass this off to aaron gronstal

85

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

who represents paige

86

00:03:28,309 --> 00:03:25,040

um hi i'm aaron gronstal i'm at the

87

00:03:30,470 --> 00:03:28,319

astrology program office and

88

00:03:32,630 --> 00:03:30,480

i've kind of lived a life in art and

89

00:03:33,910 --> 00:03:32,640

science i was uh my my mother's a visual

90

00:03:36,149 --> 00:03:33,920

artist i always grew up with the visual

91

00:03:37,990 --> 00:03:36,159

arts and drawing comic books a lot and

92

00:03:39,190 --> 00:03:38,000

painting and that sort of thing actually

93

00:03:41,190 --> 00:03:39,200

my first degree in theater and

94

00:03:43,509 --> 00:03:41,200

performance studies

95

00:03:46,390 --> 00:03:43,519

my first like actual paycheck was as an

96

00:03:49,509 --> 00:03:46,400

actor in australia

97

00:03:50,869 --> 00:03:49,519

and i wrote a piece that was a theater

98

00:03:53,030 --> 00:03:50,879

piece about um

99

00:03:54,149 --> 00:03:53,040

basically translating my anatomy notes

100

00:03:55,990 --> 00:03:54,159

into

101
00:03:57,670 --> 00:03:56,000
i needed to memorize for an exam so i

102
00:03:58,789 --> 00:03:57,680
wrote a play that went through all of my

103
00:03:59,910 --> 00:03:58,799
notes and

104
00:04:02,470 --> 00:03:59,920
and that got picked up by the

105
00:04:05,429 --> 00:04:02,480
international writers festival but

106
00:04:10,630 --> 00:04:08,470
but uh so so then i but i came back and

107
00:04:13,030 --> 00:04:10,640
went back into science and ended up

108
00:04:15,750 --> 00:04:13,040
at the astrobiology program office but

109
00:04:18,390 --> 00:04:15,760
have always continued my art and and

110
00:04:19,909 --> 00:04:18,400
i always found it as an outlet and

111
00:04:22,870 --> 00:04:19,919
when the 50th anniversary of

112
00:04:24,469 --> 00:04:22,880
astrobiology came up uh mary wojtek

113
00:04:26,550 --> 00:04:24,479

and linda billings who are also both at

114

00:04:29,510 --> 00:04:26,560

the astrobiology program office really

115

00:04:30,710 --> 00:04:29,520

wanted to kind of uh produce something

116

00:04:32,629 --> 00:04:30,720

that we could hand out at the 50th

117

00:04:34,070 --> 00:04:32,639

anniversary and and mary knew that i

118

00:04:36,950 --> 00:04:34,080

drew a lot of comic books and that sort

119

00:04:38,950 --> 00:04:36,960

of thing in my spare time and so decided

120

00:04:41,670 --> 00:04:38,960

to make use of that and we we produced

121

00:04:43,749 --> 00:04:41,680

one just kind of as as a handout at that

122

00:04:45,189 --> 00:04:43,759

one thing but the teachers got a hold of

123

00:04:46,870 --> 00:04:45,199

it and really loved it in the classroom

124

00:04:48,070 --> 00:04:46,880

and we had a lot of requests to keep

125

00:04:49,510 --> 00:04:48,080

going so we've

126

00:04:50,950 --> 00:04:49,520

kind of kept the series going and

127

00:04:53,749 --> 00:04:50,960

released some you know at eb's icon as

128

00:04:55,830 --> 00:04:53,759

it comes around and

129

00:04:57,030 --> 00:04:55,840

need ideas for the next one so for if

130

00:04:58,710 --> 00:04:57,040

those of you in the back if you move

131

00:05:00,230 --> 00:04:58,720

forward there's free copies just sitting

132

00:05:01,990 --> 00:05:00,240

on the some of the tables up here if you

133

00:05:03,830 --> 00:05:02,000

want to take some so

134

00:05:06,870 --> 00:05:03,840

if you want to move up closer

135

00:05:15,430 --> 00:05:06,880

i also have more afterwards so

136

00:05:22,390 --> 00:05:18,790

hi i'm julie galle bagginstas and i'm a

137

00:05:24,629 --> 00:05:22,400

flamenco dancer and i have

138

00:05:27,110 --> 00:05:24,639

become interested in using flamenco

139

00:05:29,990 --> 00:05:27,120

dance movement in general but since i

140

00:05:31,990 --> 00:05:30,000

love flamenco um this this art form in

141

00:05:33,670 --> 00:05:32,000

the schools um i use it in the schools

142

00:05:34,950 --> 00:05:33,680

as a teaching artist

143

00:05:36,710 --> 00:05:34,960

to

144

00:05:38,710 --> 00:05:36,720

teach lessons about things that don't

145

00:05:41,350 --> 00:05:38,720

really have anything to do with dance

146

00:05:44,550 --> 00:05:41,360

such as math and

147

00:05:45,990 --> 00:05:44,560

as well social studies i am based in

148

00:05:49,110 --> 00:05:46,000

atlanta

149

00:05:51,189 --> 00:05:49,120

but i work throughout the country i am

150

00:05:53,510 --> 00:05:51,199

performing and teaching and also

151
00:05:56,150 --> 00:05:53,520
producing work for

152
00:05:58,150 --> 00:05:56,160
my colleagues in the art form who are

153
00:06:00,950 --> 00:05:58,160
based here in the u.s and also

154
00:06:02,870 --> 00:06:00,960
visiting from spain so i'm really

155
00:06:03,670 --> 00:06:02,880
feeling like i'm in great company here

156
00:06:04,390 --> 00:06:03,680
with

157
00:06:07,270 --> 00:06:04,400
some

158
00:06:09,430 --> 00:06:07,280
fantastic artists and scientists and so

159
00:06:11,990 --> 00:06:09,440
um thank you for letting me join the

160
00:06:16,070 --> 00:06:13,029
thank you

161
00:06:18,230 --> 00:06:16,080
this mic doesn't seem to be working

162
00:06:19,270 --> 00:06:18,240
i'm larry niven

163
00:06:25,189 --> 00:06:19,280

i

164

00:06:26,990 --> 00:06:25,199
for 58 years

165

00:06:30,629 --> 00:06:27,000
and for that long i've been doing

166

00:06:32,230 --> 00:06:30,639
astrobiology without actually naming it

167

00:06:33,110 --> 00:06:32,240
uh

168

00:06:37,029 --> 00:06:33,120
the

169

00:06:39,189 --> 00:06:37,039
do do you need to know more than that

170

00:06:44,230 --> 00:06:39,199
about me

171

00:06:45,670 --> 00:06:44,240
uh i i am i live i live a dull life

172

00:06:51,510 --> 00:06:45,680
uh

173

00:06:57,189 --> 00:06:51,520
and

174

00:07:02,710 --> 00:07:00,629
howdy i'm tim griffin uh i am a stem

175

00:07:05,909 --> 00:07:02,720
educator from los angeles

176

00:07:08,469 --> 00:07:05,919

and i'm also a musician and i brought

177

00:07:11,909 --> 00:07:08,479

those two together by starting to write

178

00:07:13,589 --> 00:07:11,919

songs about 30 years ago for my students

179

00:07:16,150 --> 00:07:13,599

to help them learn about science and

180

00:07:18,070 --> 00:07:16,160

math and other subjects and eventually

181

00:07:21,189 --> 00:07:18,080

writing songs with them

182

00:07:23,350 --> 00:07:21,199

and the music for education grew into a

183

00:07:25,749 --> 00:07:23,360

second full-time job so i now run a

184

00:07:27,670 --> 00:07:25,759

small non-profit called griffin

185

00:07:30,950 --> 00:07:27,680

education where i lead a team of

186

00:07:33,830 --> 00:07:30,960

educators and musicians and scientists

187

00:07:35,589 --> 00:07:33,840

too and we make and give away songs that

188

00:07:37,749 --> 00:07:35,599

help kids learn about physics and

189

00:07:40,390 --> 00:07:37,759

biology and grammar and all kinds of fun

190

00:07:42,230 --> 00:07:40,400

stuff so i'm super excited to be here

191

00:07:44,150 --> 00:07:42,240

because i've already met a bunch of

192

00:07:45,430 --> 00:07:44,160

potential collaborators and they don't

193

00:07:47,029 --> 00:07:45,440

know but i'm going to be stalking them

194

00:07:48,869 --> 00:07:47,039

online until i get them to help me write

195

00:07:50,710 --> 00:07:48,879

some new songs about stuff that i don't

196

00:07:55,510 --> 00:07:50,720

know enough about to tell the stories

197

00:08:00,550 --> 00:07:58,230

okay great thank you all so much so erin

198

00:08:02,469 --> 00:08:00,560

i am going to pick on you since you

199

00:08:05,510 --> 00:08:02,479

mentioned these fantastic

200

00:08:08,550 --> 00:08:05,520

uh graphic novels so what made you desi

201
00:08:10,869 --> 00:08:08,560
decide to use your superpowers to you

202
00:08:13,110 --> 00:08:10,879
know go through go into science and

203
00:08:16,629 --> 00:08:13,120
science communication and in a way

204
00:08:20,150 --> 00:08:18,309
let's see i i kind of actually when i

205
00:08:22,230 --> 00:08:20,160
started at nasa it was kind of i was an

206
00:08:24,309 --> 00:08:22,240
undergrad and i was

207
00:08:25,749 --> 00:08:24,319
studying molecular environmental biology

208
00:08:28,390 --> 00:08:25,759
how long

209
00:08:29,589 --> 00:08:28,400
degree in theater and um

210
00:08:34,310 --> 00:08:29,599
i

211
00:08:37,190 --> 00:08:35,509
and

212
00:08:39,269 --> 00:08:37,200
that summer i was going to stay around

213
00:08:41,029 --> 00:08:39,279

in berkeley and

214

00:08:43,269 --> 00:08:41,039

randomly emailed a person on the website

215

00:08:45,269 --> 00:08:43,279

saying hey i'm you know studying

216

00:08:47,110 --> 00:08:45,279

microbiology but i'm also studying

217

00:08:49,509 --> 00:08:47,120

theater and writing and is there

218

00:08:51,269 --> 00:08:49,519

anything i can do this summer and

219

00:08:52,310 --> 00:08:51,279

they email me back and they're like sure

220

00:08:53,590 --> 00:08:52,320

like come down

221

00:08:55,590 --> 00:08:53,600

and do some writing for us they needed

222

00:08:57,990 --> 00:08:55,600

somebody to do some that had a knowledge

223

00:08:59,190 --> 00:08:58,000

of science to do some writing and

224

00:09:01,829 --> 00:08:59,200

yeah it kind of

225

00:09:05,990 --> 00:09:01,839

i had they just gave me a desk in a room

226

00:09:10,710 --> 00:09:08,790

and yeah i just kind of never left but i

227

00:09:12,310 --> 00:09:10,720

continued school while i was i was doing

228

00:09:13,829 --> 00:09:12,320

that with yes which was the astrobiology

229

00:09:14,949 --> 00:09:13,839

integration office at the at the time

230

00:09:17,990 --> 00:09:14,959

before it was

231

00:09:19,590 --> 00:09:18,000

a program at nasa headquarters and

232

00:09:21,509 --> 00:09:19,600

then for

233

00:09:23,430 --> 00:09:21,519

like kept on with science stayed with

234

00:09:25,269 --> 00:09:23,440

science at nasa and then

235

00:09:27,269 --> 00:09:25,279

came back around to the art when when uh

236

00:09:29,509 --> 00:09:27,279

mary kind of approached me about doing

237

00:09:30,870 --> 00:09:29,519

the the comics and linda billings had

238

00:09:32,470 --> 00:09:30,880

really had played a big role in that

239

00:09:33,990 --> 00:09:32,480

who's the editor um

240

00:09:35,190 --> 00:09:34,000

on that and who has

241

00:09:37,590 --> 00:09:35,200

done

242

00:09:39,670 --> 00:09:37,600

a lot of kind of academic study of comic

243

00:09:44,710 --> 00:09:39,680

art and that sort of thing so we kind of

244

00:09:48,710 --> 00:09:46,800

the secret history of aaron

245

00:09:50,470 --> 00:09:48,720

[Laughter]

246

00:09:52,949 --> 00:09:50,480

who i've known for ages and i just keep

247

00:09:59,110 --> 00:09:56,150

julia i wanted to ask you a question um

248

00:10:02,150 --> 00:09:59,120

so i'm curious about how you see the

249

00:10:05,670 --> 00:10:02,160

relationship between your craft dance

250

00:10:07,350 --> 00:10:05,680

your art and science and the disciplines

251

00:10:09,590 --> 00:10:07,360

that you've worked with

252

00:10:12,230 --> 00:10:09,600

especially mathematics

253

00:10:17,110 --> 00:10:12,240

what are the connections there i i can

254

00:10:21,670 --> 00:10:20,230

so there are there are the obvious um

255

00:10:23,910 --> 00:10:21,680

what i kind of call the obvious

256

00:10:26,389 --> 00:10:23,920

connections um between um

257

00:10:29,269 --> 00:10:26,399

between dance and music because we're

258

00:10:31,910 --> 00:10:29,279

moving to to rhythm there and math and

259

00:10:34,550 --> 00:10:31,920

that's infractions and so that's the

260

00:10:35,269 --> 00:10:34,560

easy one to go into a classroom and talk

261

00:10:37,590 --> 00:10:35,279

to

262

00:10:39,190 --> 00:10:37,600

students about by the way i work a lot

263

00:10:40,949 --> 00:10:39,200

with k through 12

264

00:10:42,470 --> 00:10:40,959

students i also work at the university

265

00:10:45,750 --> 00:10:42,480

level but the majority of my work as a

266

00:10:47,190 --> 00:10:45,760

teaching artist is with k-12 in in k-12

267

00:10:49,750 --> 00:10:47,200

classrooms so that's the environment

268

00:10:51,829 --> 00:10:49,760

that i'm thinking of um so that's the

269

00:10:54,389 --> 00:10:51,839

that's the the one that jumps out there

270

00:10:57,030 --> 00:10:54,399

um fractions there are some other

271

00:11:00,069 --> 00:10:57,040

connections um in terms of um moving

272

00:11:01,670 --> 00:11:00,079

bodies um to think about including um

273

00:11:04,630 --> 00:11:01,680

geometry

274

00:11:07,269 --> 00:11:04,640

and to help kids start to understand um

275

00:11:09,030 --> 00:11:07,279

the shapes in terms of related relating

276

00:11:10,630 --> 00:11:09,040

movement to shapes

277

00:11:13,269 --> 00:11:10,640

and then to ask them

278

00:11:15,190 --> 00:11:13,279

what do they see there to get them

279

00:11:16,949 --> 00:11:15,200

thinking on their terms instead of say

280

00:11:18,790 --> 00:11:16,959

the teachers terms

281

00:11:20,790 --> 00:11:18,800

there are some other

282

00:11:21,829 --> 00:11:20,800

other connections that i've learned to

283

00:11:24,470 --> 00:11:21,839

use

284

00:11:26,550 --> 00:11:24,480

including just some basic math skills of

285

00:11:29,829 --> 00:11:26,560

of counting and addition and subtraction

286

00:11:32,550 --> 00:11:29,839

at the very um the very

287

00:11:35,750 --> 00:11:32,560

basic level for younger students um and

288

00:11:38,630 --> 00:11:35,760

then as we get farther ahead with older

289

00:11:40,790 --> 00:11:38,640

audiences or older classrooms

290

00:11:43,030 --> 00:11:40,800

i like to try to challenge the students

291

00:11:45,190 --> 00:11:43,040

to think a little bit more abstractly

292

00:11:48,150 --> 00:11:45,200

and this is where my interest in the

293

00:11:50,870 --> 00:11:48,160

ellipse comes in with the two foci and

294

00:11:53,509 --> 00:11:50,880

its connection to flamenco for me

295

00:11:55,910 --> 00:11:53,519

came about because i see our rhythms we

296

00:11:57,750 --> 00:11:55,920

use what we call contra tiempos

297

00:11:59,829 --> 00:11:57,760

so there's the bass beat and then

298

00:12:01,509 --> 00:11:59,839

there's the the counter to that um the

299

00:12:05,030 --> 00:12:01,519

eighth note for the musicians in the

300

00:12:07,670 --> 00:12:05,040

room um the the standard of excellence

301

00:12:10,629 --> 00:12:07,680

now is to work in the contra tiempo

302

00:12:13,269 --> 00:12:10,639

rather than working on the beat um

303

00:12:14,069 --> 00:12:13,279

and so in the ellipse in the

304

00:12:21,269 --> 00:12:14,079

the

305

00:12:23,590 --> 00:12:21,279

with elena del rio para who is here at

306

00:12:26,150 --> 00:12:23,600

georgia state university um in world

307

00:12:29,190 --> 00:12:26,160

languages um she introduced me to this

308

00:12:31,829 --> 00:12:29,200

idea that that these these two foci um

309

00:12:33,590 --> 00:12:31,839

in visual art um one will stand out and

310

00:12:36,310 --> 00:12:33,600

one will recede and this is actually a

311

00:12:38,710 --> 00:12:36,320

theory by severus ardui who's a cuban

312

00:12:40,949 --> 00:12:38,720

poet um so you've got something standing

313

00:12:43,509 --> 00:12:40,959

out in something receding and so for me

314

00:12:44,470 --> 00:12:43,519

this is our contra tiempo in flamenco

315

00:12:46,949 --> 00:12:44,480

and that

316

00:12:49,509 --> 00:12:46,959

that we're trying to constantly um

317

00:12:51,829 --> 00:12:49,519

emphasize the part of the beat that

318

00:12:53,430 --> 00:12:51,839

doesn't really exist the anti-rhythm in

319

00:12:55,110 --> 00:12:53,440

my opinion

320

00:12:57,509 --> 00:12:55,120

and then we're not just trying to

321

00:12:59,190 --> 00:12:57,519

emphasize it but then subdivide it and

322

00:13:01,509 --> 00:12:59,200

so to get the students to think

323

00:13:02,629 --> 00:13:01,519

abstractly in terms of something that

324

00:13:04,790 --> 00:13:02,639

might

325

00:13:06,790 --> 00:13:04,800

appear to stand out and something that

326

00:13:09,190 --> 00:13:06,800

might recede is another way to get them

327

00:13:11,030 --> 00:13:09,200

to start to um

328

00:13:12,949 --> 00:13:11,040

to think about this ellipse and then so

329

00:13:15,670 --> 00:13:12,959

many other things use that as a metaphor

330

00:13:17,590 --> 00:13:15,680

for so many other things in life um in

331

00:13:19,350 --> 00:13:17,600

all the places that we find in balance

332

00:13:20,949 --> 00:13:19,360

and so this is where a connection comes

333

00:13:24,790 --> 00:13:20,959

in

334

00:13:26,150 --> 00:13:24,800

between mathematics and the work that i

335

00:13:28,230 --> 00:13:26,160

do

336

00:13:30,550 --> 00:13:28,240

staying in the lane of math and then

337

00:13:32,949 --> 00:13:30,560

also getting outside of there

338

00:13:35,269 --> 00:13:32,959

for some some abstract

339

00:13:37,430 --> 00:13:35,279

thought and creativity

340

00:13:40,389 --> 00:13:37,440

yeah wow thank you so much julie so now

341

00:13:41,590 --> 00:13:40,399

we we see that through dance and so tim

342

00:13:44,230 --> 00:13:41,600

i'm wondering

343

00:13:46,870 --> 00:13:44,240

now with your craft what how you see a

344

00:13:48,550 --> 00:13:46,880

connection between art and science and

345

00:13:49,350 --> 00:13:48,560

conveying these topics through what you

346

00:13:51,509 --> 00:13:49,360

do

347

00:13:54,389 --> 00:13:51,519

yeah there's there are all kinds of ways

348

00:13:56,710 --> 00:13:54,399

that one can help you to bridge the gaps

349

00:13:59,509 --> 00:13:56,720

for the other uh you know thinking about

350

00:14:01,189 --> 00:13:59,519

flamenco dancing for for one example is

351
00:14:03,269 --> 00:14:01,199
a great way to teach fundamental

352
00:14:05,189 --> 00:14:03,279
concepts like temperature

353
00:14:07,590 --> 00:14:05,199
because flamenco you're mostly

354
00:14:10,389 --> 00:14:07,600
stationary and yet you're constantly

355
00:14:12,470 --> 00:14:10,399
moving non-stop and as the music gets

356
00:14:14,069 --> 00:14:12,480
faster that's that's temperature right

357
00:14:16,230 --> 00:14:14,079
that's what heat really is there's an

358
00:14:17,829 --> 00:14:16,240
atom and it may be more or less in the

359
00:14:20,310 --> 00:14:17,839
same place but it's moving faster and

360
00:14:23,030 --> 00:14:20,320
faster and then other kinds of dancing

361
00:14:26,710 --> 00:14:23,040
you think about square dancing or uh

362
00:14:27,990 --> 00:14:26,720
quadrils or regency dancing where

363
00:14:30,150 --> 00:14:28,000

people are moving around and they're

364

00:14:32,710 --> 00:14:30,160

never quite touching but there's a very

365

00:14:35,509 --> 00:14:32,720

defined structure in terms of their

366

00:14:37,910 --> 00:14:35,519

physical relationships to each other i

367

00:14:39,750 --> 00:14:37,920

can think of no better way to teach how

368

00:14:41,430 --> 00:14:39,760

molecules are assembled you know you

369

00:14:43,350 --> 00:14:41,440

think about you know larry you've been

370

00:14:45,590 --> 00:14:43,360

to regency dancing with me you

371

00:14:47,750 --> 00:14:45,600

introduced me to it and you get a long

372

00:14:49,910 --> 00:14:47,760

line of couples facing each other and

373

00:14:51,990 --> 00:14:49,920

moving around and you know slowly

374

00:14:55,590 --> 00:14:52,000

peeling off and then reassembling the

375

00:14:57,670 --> 00:14:55,600

formation up at the top that's dna

376

00:14:59,509 --> 00:14:57,680

so you know the arts are such a great

377

00:15:11,030 --> 00:14:59,519

way to teach the things that we can't

378

00:15:16,629 --> 00:15:12,949

it's okay

379

00:15:18,069 --> 00:15:16,639

so larry i want to ask you a question

380

00:15:19,910 --> 00:15:18,079

which is um

381

00:15:22,710 --> 00:15:19,920

larry and i had a chance to talk about

382

00:15:24,389 --> 00:15:22,720

this and he knows that i am a big fan of

383

00:15:27,350 --> 00:15:24,399

his books and

384

00:15:29,829 --> 00:15:27,360

i was a huge fan of moting god's eye and

385

00:15:32,790 --> 00:15:29,839

ring world and your books really helped

386

00:15:34,150 --> 00:15:32,800

me think about you know imagining these

387

00:15:36,790 --> 00:15:34,160

other places and now i'm an

388

00:15:38,550 --> 00:15:36,800

astrobiologist and i get to study those

389

00:15:40,629 --> 00:15:38,560

those kinds of

390

00:15:43,590 --> 00:15:40,639

imaginary worlds that might

391

00:15:46,710 --> 00:15:43,600

have life for a day job and i wanted to

392

00:15:48,949 --> 00:15:46,720

know larry um did you ever work with

393

00:15:50,949 --> 00:15:48,959

scientists as part of your creative

394

00:15:53,749 --> 00:15:50,959

process were you

395

00:15:54,550 --> 00:15:53,759

looking into the scientific literature

396

00:15:56,790 --> 00:15:54,560

um

397

00:15:58,790 --> 00:15:56,800

was that part of how you

398

00:16:01,509 --> 00:15:58,800

you worked on world building did you

399

00:16:03,990 --> 00:16:01,519

work with scientists on doing that too

400

00:16:08,790 --> 00:16:04,000

in your creative process

401
00:16:10,230 --> 00:16:08,800
it's a yes but then but not very much

402
00:16:12,150 --> 00:16:10,240
do you know the name

403
00:16:17,350 --> 00:16:12,160
robert forward

404
00:16:19,269 --> 00:16:17,360
what was with hughes research

405
00:16:20,829 --> 00:16:19,279
designing a uh

406
00:16:22,470 --> 00:16:20,839
a gravity

407
00:16:24,230 --> 00:16:22,480
detector

408
00:16:26,230 --> 00:16:24,240
when uh

409
00:16:31,430 --> 00:16:26,240
when jerry bornell wrote us and wrote a

410
00:16:31,440 --> 00:16:35,030
beat him into print

411
00:16:39,269 --> 00:16:38,470
forward called to jerry jerry called me

412
00:16:40,069 --> 00:16:39,279
uh

413
00:16:46,550 --> 00:16:40,079

we

414

00:16:47,509 --> 00:16:46,560

and uh and i learned about quantum black

415

00:16:49,189 --> 00:16:47,519

holes

416

00:16:51,749 --> 00:16:49,199

they were called then

417

00:16:52,790 --> 00:16:51,759

now many black holes

418

00:16:56,470 --> 00:16:52,800

uh

419

00:17:00,069 --> 00:16:56,480

we jerry and i and some others persuaded

420

00:17:02,230 --> 00:17:00,079

robert forward to write science fiction

421

00:17:06,069 --> 00:17:02,240

so there's certainly a connection in

422

00:17:07,669 --> 00:17:06,079

there also i sent jerry i sent

423

00:17:08,390 --> 00:17:07,679

robert forward

424

00:17:09,270 --> 00:17:08,400

uh

425

00:17:10,870 --> 00:17:09,280

these

426
00:17:12,949 --> 00:17:10,880
specs

427
00:17:14,710 --> 00:17:12,959
the outline for

428
00:17:16,390 --> 00:17:14,720
the integral trees

429
00:17:18,309 --> 00:17:16,400
back when it was called

430
00:17:22,789 --> 00:17:18,319
the uh

431
00:17:25,429 --> 00:17:22,799
or something

432
00:17:27,270 --> 00:17:25,439
i had to change it because robert looked

433
00:17:30,549 --> 00:17:27,280
my specs over

434
00:17:33,990 --> 00:17:30,559
told me i was not crazy

435
00:17:35,669 --> 00:17:34,000
and uh and told me what the tides around

436
00:17:37,590 --> 00:17:35,679
a neutron star

437
00:17:41,510 --> 00:17:37,600
would do to the winds

438
00:17:44,310 --> 00:17:41,520

around a like a flock of trees in a

439

00:17:45,750 --> 00:17:44,320

in a gas taurus

440

00:17:48,070 --> 00:17:45,760

held by the by

441

00:17:49,029 --> 00:17:48,080

neutron star diets

442

00:17:51,270 --> 00:17:49,039

yeah

443

00:17:56,390 --> 00:17:51,280

that that that was a

444

00:17:59,190 --> 00:17:57,990

that is and so larry actually i've got a

445

00:18:00,470 --> 00:17:59,200

follow-up

446

00:18:04,950 --> 00:18:00,480

what could you share a little bit about

447

00:18:08,789 --> 00:18:06,230

could you share a little bit about what

448

00:18:11,110 --> 00:18:08,799

your creative process looks like for

449

00:18:15,510 --> 00:18:11,120

writing a novel

450

00:18:21,110 --> 00:18:19,430

i've listed myself as a a dilettante i'm

451
00:18:22,150 --> 00:18:21,120
not one of the uh

452
00:18:24,549 --> 00:18:22,160
really

453
00:18:26,870 --> 00:18:24,559
good writers who can write when they

454
00:18:29,990 --> 00:18:26,880
don't feel like writing

455
00:18:31,190 --> 00:18:30,000
uh i've gotten along with it along with

456
00:18:33,190 --> 00:18:31,200
this

457
00:18:35,990 --> 00:18:33,200
uh handicap

458
00:18:42,950 --> 00:18:36,000
for uh 58 years

459
00:18:49,110 --> 00:18:46,230
i i use a i use a computer

460
00:18:51,909 --> 00:18:49,120
i've used a computer ever since uh the

461
00:18:52,789 --> 00:18:51,919
middle of the integral trees so i'm

462
00:18:53,830 --> 00:18:52,799
sorry

463
00:18:57,029 --> 00:18:53,840

the uh

464

00:18:57,990 --> 00:18:57,039

the ring world engineers jerry pornell

465

00:19:00,310 --> 00:18:58,000

made me

466

00:19:02,470 --> 00:19:00,320

get a computer back when that was a

467

00:19:06,070 --> 00:19:02,480

whole new idea

468

00:19:10,710 --> 00:19:08,390

he put his together

469

00:19:13,750 --> 00:19:10,720

to fit the needs of a writer

470

00:19:16,150 --> 00:19:13,760

with the help of a guy named tony peach

471

00:19:18,710 --> 00:19:16,160

our computer man

472

00:19:20,070 --> 00:19:18,720

and when he had here is perfect he made

473

00:19:21,990 --> 00:19:20,080

me buy one

474

00:19:24,390 --> 00:19:22,000

and i bought two

475

00:19:26,310 --> 00:19:24,400

because my wife is a computer

476

00:19:27,669 --> 00:19:26,320

uh honcho

477

00:19:30,310 --> 00:19:27,679

and uh

478

00:19:33,190 --> 00:19:30,320

and she needed one to play with

479

00:19:38,230 --> 00:19:33,200

and it got me spare parts

480

00:19:42,470 --> 00:19:40,710

thank you so much and so heather and uh

481

00:19:42,900 --> 00:19:42,480

erin

482

00:19:44,230 --> 00:19:42,910

when you're

483

00:19:46,870 --> 00:19:44,240

[Music]

484

00:19:49,750 --> 00:19:46,880

thinking about your science and needing

485

00:19:53,270 --> 00:19:49,760

to convey it through artistic means does

486

00:20:01,440 --> 00:19:53,280

it force you to think about your science

487

00:20:05,270 --> 00:20:03,510

[Laughter]

488

00:20:06,710 --> 00:20:05,280

yeah that's an interesting question

489

00:20:08,789 --> 00:20:06,720

because i think the easy answer would be

490

00:20:10,630 --> 00:20:08,799

like oh yeah if i want to convey my

491

00:20:12,549 --> 00:20:10,640

science through artistic things i have

492

00:20:14,390 --> 00:20:12,559

to do oh i have to dumb it down or make

493

00:20:15,669 --> 00:20:14,400

it easier and actually that's not true

494

00:20:17,830 --> 00:20:15,679

at all because

495

00:20:20,149 --> 00:20:17,840

um you have to con you have to figure

496

00:20:23,430 --> 00:20:20,159

out how to encapsulate so much of your

497

00:20:25,830 --> 00:20:23,440

knowledge into much more simple

498

00:20:27,430 --> 00:20:25,840

not simple you have to compact it you

499

00:20:28,789 --> 00:20:27,440

have to think about how you are going to

500

00:20:30,710 --> 00:20:28,799

take all of that body of knowledge

501
00:20:32,870 --> 00:20:30,720
that's inherent to you that's almost

502
00:20:35,029 --> 00:20:32,880
almost instinctual because you've been

503
00:20:37,190 --> 00:20:35,039
you know marinating in these scientific

504
00:20:40,549 --> 00:20:37,200
topics for a decade and figure out how

505
00:20:42,950 --> 00:20:40,559
to get that into a compact way that it's

506
00:20:45,029 --> 00:20:42,960
it's convenient for

507
00:20:47,830 --> 00:20:45,039
a novice who doesn't have those decades

508
00:20:49,270 --> 00:20:47,840
to understand and that's actually hugely

509
00:20:51,669 --> 00:20:49,280
challenging it's probably more

510
00:20:54,549 --> 00:20:51,679
challenging to try to figure out how to

511
00:20:55,909 --> 00:20:54,559
do that compacting process than to you

512
00:20:58,710 --> 00:20:55,919
know leisurely

513
00:21:00,870 --> 00:20:58,720

draw out over many pages of you know

514

00:21:03,590 --> 00:21:00,880

materials and methods of your usual

515

00:21:05,510 --> 00:21:03,600

scientific uh publication you know when

516

00:21:07,430 --> 00:21:05,520

you're trying to do that so actually i

517

00:21:09,110 --> 00:21:07,440

think it's a lot more challenging and i

518

00:21:11,909 --> 00:21:09,120

think the other thing it really does is

519

00:21:13,990 --> 00:21:11,919

it makes you think about

520

00:21:16,149 --> 00:21:14,000

what is the core message here that i'm

521

00:21:17,590 --> 00:21:16,159

trying to get across

522

00:21:20,310 --> 00:21:17,600

and that's something that's

523

00:21:22,870 --> 00:21:20,320

much more important in an artistic thing

524

00:21:24,870 --> 00:21:22,880

um where you you want your audience you

525

00:21:25,830 --> 00:21:24,880

want the people who are

526
00:21:27,590 --> 00:21:25,840
you know

527
00:21:29,669 --> 00:21:27,600
taking the time out of their day to to

528
00:21:30,470 --> 00:21:29,679
listen to you or or view your piece you

529
00:21:32,230 --> 00:21:30,480
want

530
00:21:34,630 --> 00:21:32,240
to have an idea of what they're going to

531
00:21:36,789 --> 00:21:34,640
leave with what is the important element

532
00:21:38,549 --> 00:21:36,799
they leave with and you know when you're

533
00:21:41,510 --> 00:21:38,559
writing a scientific paper that can be

534
00:21:43,669 --> 00:21:41,520
many things and you have you know uh

535
00:21:45,590 --> 00:21:43,679
pages to put that out there but you know

536
00:21:47,190 --> 00:21:45,600
in art you really have to distill it

537
00:21:49,190 --> 00:21:47,200
down and that's actually a really tough

538
00:21:51,029 --> 00:21:49,200

process so it's actually harder it's not

539

00:21:53,350 --> 00:21:51,039

just you know cutting off the hard parts

540

00:21:54,950 --> 00:21:53,360

and and simplifying

541

00:21:56,470 --> 00:21:54,960

and i definitely agree with that

542

00:21:57,909 --> 00:21:56,480

the distillation is

543

00:21:58,630 --> 00:21:57,919

can be really difficult and like with

544

00:22:03,270 --> 00:21:58,640

the

545

00:22:04,630 --> 00:22:03,280

what i love about it is that

546

00:22:06,230 --> 00:22:04,640

you're kind of working in two languages

547

00:22:08,950 --> 00:22:06,240

at the same time

548

00:22:10,230 --> 00:22:08,960

we think of comics as being sort of a

549

00:22:11,990 --> 00:22:10,240

a modern

550

00:22:13,270 --> 00:22:12,000

way of storytelling but it's really not

551

00:22:15,350 --> 00:22:13,280

i mean comics are a form of visual

552

00:22:18,870 --> 00:22:15,360

storytelling and visual storytelling is

553

00:22:21,510 --> 00:22:18,880

a language that has been with us

554

00:22:23,390 --> 00:22:21,520

for for so long and i think

555

00:22:25,029 --> 00:22:23,400

yeah i mean i think it was at least in

556

00:22:27,190 --> 00:22:25,039

2018

557

00:22:28,950 --> 00:22:27,200

the oldest one was in like the oldest

558

00:22:31,990 --> 00:22:28,960

cave paintings were found in indonesia

559

00:22:35,350 --> 00:22:32,000

and it was they're 44 000 years old

560

00:22:37,190 --> 00:22:35,360

and it depicts a hunting story and it's

561

00:22:39,110 --> 00:22:37,200

we can still read them

562

00:22:39,990 --> 00:22:39,120

you know like we today can still read

563

00:22:41,029 --> 00:22:40,000

them and i think that visual

564

00:22:42,549 --> 00:22:41,039

storytelling is something that's

565

00:22:43,430 --> 00:22:42,559

ingrained in all of us

566

00:22:45,830 --> 00:22:43,440

and

567

00:22:46,789 --> 00:22:45,840

so the comic art is this beautiful way

568

00:22:48,549 --> 00:22:46,799

of

569

00:22:50,310 --> 00:22:48,559

speaking to a reader

570

00:22:51,830 --> 00:22:50,320

in two languages at the same time one

571

00:22:53,430 --> 00:22:51,840

that's visual one that is words and

572

00:22:55,110 --> 00:22:53,440

there are people that connect with each

573

00:22:56,789 --> 00:22:55,120

of those in different ways

574

00:22:58,470 --> 00:22:56,799

and better some people are very visual

575

00:23:01,430 --> 00:22:58,480

learners so it's it's

576

00:23:03,270 --> 00:23:01,440

so fun to take a concept and be okay

577

00:23:05,110 --> 00:23:03,280

i can talk about it here but then i'm

578

00:23:06,789 --> 00:23:05,120

going to talk about it in this way in a

579

00:23:08,149 --> 00:23:06,799

completely different language and they

580

00:23:09,750 --> 00:23:08,159

can't you don't want them to say the

581

00:23:12,789 --> 00:23:09,760

same thing like one of the golden kind

582

00:23:14,149 --> 00:23:12,799

of rules of comics is you know you don't

583

00:23:16,390 --> 00:23:14,159

you don't want to draw a picture of

584

00:23:18,149 --> 00:23:16,400

batman punching the joker and then say

585

00:23:19,750 --> 00:23:18,159

and then batman punch the joker in the

586

00:23:21,830 --> 00:23:19,760

text like you shouldn't have to do that

587

00:23:23,590 --> 00:23:21,840

if you if you have to do that then the

588

00:23:25,270 --> 00:23:23,600

you've failed in the in the artwork like

589

00:23:26,310 --> 00:23:25,280

the artwork should show that you know

590

00:23:28,950 --> 00:23:26,320

and so

591

00:23:31,190 --> 00:23:28,960

you can kind of in that one panel

592

00:23:33,990 --> 00:23:31,200

convey a lot of information between the

593

00:23:35,510 --> 00:23:34,000

words and the in the images in in unique

594

00:23:36,870 --> 00:23:35,520

ways and

595

00:23:38,390 --> 00:23:36,880

that's one of the really fun parts about

596

00:23:39,669 --> 00:23:38,400

comics and it was really interesting

597

00:23:41,430 --> 00:23:39,679

when we started

598

00:23:42,310 --> 00:23:41,440

uh the series

599

00:23:45,110 --> 00:23:42,320

which

600

00:23:46,870 --> 00:23:45,120

contains real scientists and their real

601
00:23:48,149 --> 00:23:46,880
work and it has academic references in

602
00:23:49,990 --> 00:23:48,159
the back and

603
00:23:52,149 --> 00:23:50,000
um the scientists that are in it you

604
00:23:53,750 --> 00:23:52,159
know we send it a copy in advance so

605
00:23:55,430 --> 00:23:53,760
they can see their likeness and approve

606
00:23:57,190 --> 00:23:55,440
it and approve what they're saying

607
00:23:58,789 --> 00:23:57,200
and when we first started you know i'd

608
00:24:00,470 --> 00:23:58,799
kind of put together the script and and

609
00:24:02,070 --> 00:24:00,480
do the draft drawings and stuff and send

610
00:24:03,190 --> 00:24:02,080
it to the scientists and

611
00:24:04,470 --> 00:24:03,200
there were a couple that you'd get back

612
00:24:06,070 --> 00:24:04,480
and they're like oh no no i have to say

613
00:24:06,950 --> 00:24:06,080

this and they send you three pages of

614

00:24:08,470 --> 00:24:06,960

text

615

00:24:10,149 --> 00:24:08,480

and it's like no that's

616

00:24:11,269 --> 00:24:10,159

that's not how comments work i can't put

617

00:24:12,549 --> 00:24:11,279

on you know

618

00:24:14,870 --> 00:24:12,559

i'll give you i'll give you one extra

619

00:24:16,470 --> 00:24:14,880

sentence

620

00:24:18,549 --> 00:24:16,480

and so it's been this back and forth of

621

00:24:20,470 --> 00:24:18,559

distilling that real core information

622

00:24:21,990 --> 00:24:20,480

out of it and it's been

623

00:24:23,830 --> 00:24:22,000

fun

624

00:24:25,590 --> 00:24:23,840

as the series has gone along i think our

625

00:24:26,310 --> 00:24:25,600

community and the people that have kind

626
00:24:27,750 --> 00:24:26,320
of

627
00:24:29,269 --> 00:24:27,760
familiarized themselves with the books

628
00:24:30,630 --> 00:24:29,279
it's gotten easier like the scientists

629
00:24:31,350 --> 00:24:30,640
are getting you know it's like they

630
00:24:32,710 --> 00:24:31,360
think

631
00:24:35,269 --> 00:24:32,720
it's

632
00:24:36,470 --> 00:24:35,279
some scientists come up to me and say

633
00:24:37,269 --> 00:24:36,480
like that actually really helped me kind

634
00:24:39,510 --> 00:24:37,279
of

635
00:24:41,669 --> 00:24:39,520
narrow this down and and and figure out

636
00:24:43,430 --> 00:24:41,679
how i would tell this to us a classroom

637
00:24:45,430 --> 00:24:43,440
of you know five-year-olds or you know

638
00:24:49,190 --> 00:24:45,440

that kind of thing so that's it's been a

639

00:24:53,430 --> 00:24:51,510

thank you thank you so much and so tim

640

00:24:55,350 --> 00:24:53,440

do you have any tips for

641

00:24:57,990 --> 00:24:55,360

some of our audience audience members

642

00:24:59,750 --> 00:24:58,000

who are interested in you know conveying

643

00:25:01,830 --> 00:24:59,760

their science through art but might not

644

00:25:04,710 --> 00:25:01,840

really know where to start

645

00:25:08,470 --> 00:25:04,720

yeah i'd say say the first thing is

646

00:25:10,710 --> 00:25:08,480

it's it's never going to be as good as

647

00:25:14,149 --> 00:25:10,720

you pictured it in your head or heard it

648

00:25:16,310 --> 00:25:14,159

in your head or whatever and that's okay

649

00:25:19,430 --> 00:25:16,320

uh i've been performing for fun and for

650

00:25:20,950 --> 00:25:19,440

money since the 1980s and i've never had

651
00:25:22,470 --> 00:25:20,960
a perfect show i've never written a

652
00:25:24,149 --> 00:25:22,480
perfect song

653
00:25:25,830 --> 00:25:24,159
so that that's the first thing you got

654
00:25:27,990 --> 00:25:25,840
to remember

655
00:25:30,470 --> 00:25:28,000
second is you got to figure out what is

656
00:25:31,510 --> 00:25:30,480
the one thing you want people to take

657
00:25:32,870 --> 00:25:31,520
away

658
00:25:36,789 --> 00:25:32,880
you know if you're lucky they'll

659
00:25:41,909 --> 00:25:39,510
really good job it'll be the right thing

660
00:25:44,230 --> 00:25:41,919
the thing you wanted them to remember

661
00:25:45,750 --> 00:25:44,240
most songs it's something frivolous like

662
00:25:48,390 --> 00:25:45,760
wave your hands in the air like you just

663
00:25:51,510 --> 00:25:48,400

don't care and everything in the song

664

00:25:54,710 --> 00:25:51,520

every word every beat has to lead into

665

00:25:56,950 --> 00:25:54,720

supporting that one key idea

666

00:25:59,029 --> 00:25:56,960

now if we're writing about science maybe

667

00:26:00,950 --> 00:25:59,039

the idea is

668

00:26:03,830 --> 00:26:00,960

all living things are made out of cells

669

00:26:06,390 --> 00:26:03,840

you know that if that's the one big idea

670

00:26:08,149 --> 00:26:06,400

then everything in the song has to lead

671

00:26:11,190 --> 00:26:08,159

toward that and that's one of the nicest

672

00:26:13,350 --> 00:26:11,200

you to structure your thinking around a

673

00:26:16,149 --> 00:26:13,360

key idea because if you try to put all

674

00:26:19,669 --> 00:26:16,159

the information into one picture or one

675

00:26:23,590 --> 00:26:19,679

dance or one novel or one song

676

00:26:27,510 --> 00:26:25,750

i think i always put one

677

00:26:32,470 --> 00:26:27,520

at least one idea

678

00:26:36,549 --> 00:26:34,470

thank you so i want to pause right here

679

00:26:38,549 --> 00:26:36,559

and see if we have any questions from

680

00:26:40,789 --> 00:26:38,559

the audience if anybody wants to come up

681

00:26:43,669 --> 00:26:40,799

and ask a question feel free we've got

682

00:26:45,750 --> 00:26:43,679

this microphone right here um

683

00:26:47,110 --> 00:26:45,760

single file line maybe

684

00:26:58,230 --> 00:26:47,120

that'll work

685

00:26:58,240 --> 00:27:06,230

foreign

686

00:27:06,240 --> 00:27:21,430

um

687

00:27:21,440 --> 00:27:34,870

is

688

00:28:10,149 --> 00:28:07,190

uh

689

00:28:11,350 --> 00:28:10,159

i think drumming is a fantastic way to

690

00:28:14,310 --> 00:28:11,360

teach math

691

00:28:17,110 --> 00:28:14,320

because it's all about time you know and

692

00:28:19,669 --> 00:28:17,120

so measuring things and dividing them up

693

00:28:22,710 --> 00:28:19,679

into fractions and reassembling them in

694

00:28:25,190 --> 00:28:22,720

way in new ways that are exciting using

695

00:28:27,110 --> 00:28:25,200

the same parts uh to create something

696

00:28:28,789 --> 00:28:27,120

new which again is a great you know

697

00:28:30,310 --> 00:28:28,799

feedback into chemistry and and

698

00:28:32,149 --> 00:28:30,320

molecules where we take things apart and

699

00:28:34,630 --> 00:28:32,159

put them together in new ways

700

00:28:37,190 --> 00:28:34,640

so you know anything with percussion

701
00:28:39,029 --> 00:28:37,200
as far as choosing styles of music

702
00:28:41,110 --> 00:28:39,039
though i love to hand that one back to

703
00:28:42,950 --> 00:28:41,120
the students uh where if i'm with

704
00:28:44,710 --> 00:28:42,960
elementary school kids and they're doing

705
00:28:47,190 --> 00:28:44,720
the water cycle i give them an

706
00:28:49,430 --> 00:28:47,200
assignment where i want for each stage

707
00:28:51,510 --> 00:28:49,440
of the water cycle choose 20 seconds of

708
00:28:53,909 --> 00:28:51,520
music from anywhere you can find it put

709
00:28:55,590 --> 00:28:53,919
it together choreograph it

710
00:28:57,430 --> 00:28:55,600
i want to see i want you to show me

711
00:28:59,430 --> 00:28:57,440
without words that water molecules are

712
00:29:01,190 --> 00:28:59,440
evaporating and then condensing and

713
00:29:04,789 --> 00:29:01,200

precipitating and running off or

714

00:29:08,310 --> 00:29:06,149

all right thank you

715

00:29:10,149 --> 00:29:08,320

i will agree that if we have to make a

716

00:29:11,830 --> 00:29:10,159

choice let the kids make the choice as

717

00:29:14,470 --> 00:29:11,840

long as it's something that um that the

718

00:29:17,029 --> 00:29:14,480

teaching artists can handle there um

719

00:29:20,149 --> 00:29:17,039

for me though um my my preference is

720

00:29:22,389 --> 00:29:20,159

flamenco because i can see the many ways

721

00:29:24,070 --> 00:29:22,399

to subdivide the beats and then get the

722

00:29:29,110 --> 00:29:24,080

kids um

723

00:29:31,750 --> 00:29:29,120

moving and in terms of movement um we

724

00:29:34,470 --> 00:29:31,760

can have movement um

725

00:29:36,789 --> 00:29:34,480

we we have this in in dance this idea

726

00:29:40,149 --> 00:29:36,799

called the elements of dance and this is

727

00:29:42,789 --> 00:29:40,159

a a group of um labels and definitions

728

00:29:45,350 --> 00:29:42,799

that we use to talk about movement

729

00:29:48,789 --> 00:29:45,360

objectively and um it might be something

730

00:29:51,029 --> 00:29:48,799

as simple as um zigzag or straight

731

00:29:53,110 --> 00:29:51,039

sharp or smooth and so we can use these

732

00:29:57,029 --> 00:29:53,120

words to describe our movements and then

733

00:29:59,750 --> 00:29:57,039

in addition to that um use the beats to

734

00:30:03,669 --> 00:29:59,760

create movement that has high energy or

735

00:30:07,029 --> 00:30:03,679

low energy and so if we have a movement

736

00:30:09,350 --> 00:30:07,039

that is low energy and takes many beats

737

00:30:11,029 --> 00:30:09,360

of music then

738

00:30:14,310 --> 00:30:11,039

we could potentially take the same

739

00:30:16,149 --> 00:30:14,320

movement and change the energy and

740

00:30:18,389 --> 00:30:16,159

make it a faster

741

00:30:21,029 --> 00:30:18,399

movement so to speak that takes fewer

742

00:30:23,269 --> 00:30:21,039

beats and so then we start to see how

743

00:30:26,389 --> 00:30:23,279

movement can take a long time or a

744

00:30:31,110 --> 00:30:26,399

little bit of time and we can embody

745

00:30:32,549 --> 00:30:31,120

this idea of counting and math and so

746

00:30:35,510 --> 00:30:32,559

add in there for flamenco a little bit

747

00:30:37,590 --> 00:30:35,520

of percussive hand clapping and stomping

748

00:30:40,310 --> 00:30:37,600

and it really builds the excitement for

749

00:30:42,789 --> 00:30:40,320

the students i believe um but but yeah i

750

00:30:45,510 --> 00:30:42,799

mean this is this is how i see how how

751
00:30:47,029 --> 00:30:45,520
movement can be used to explain math one

752
00:30:50,149 --> 00:30:47,039
way um

753
00:30:51,830 --> 00:30:50,159
and then um yeah and then as as if if

754
00:30:54,310 --> 00:30:51,840
you like a certain kind of music let's

755
00:30:57,750 --> 00:30:54,320
use that and let's talk about that first

756
00:31:02,310 --> 00:31:00,230
thank you all um for the weather from

757
00:31:05,110 --> 00:31:02,320
harvard university um

758
00:31:07,190 --> 00:31:05,120
i have a little question and uh one

759
00:31:09,750 --> 00:31:07,200
request

760
00:31:13,509 --> 00:31:09,760
so the question is um through the

761
00:31:15,669 --> 00:31:13,519
enlightenment period 17th century 18 up

762
00:31:17,470 --> 00:31:15,679
to the 19th century

763
00:31:20,630 --> 00:31:17,480

we have this uh

764

00:31:23,750 --> 00:31:20,640

non-dissociation between art and science

765

00:31:26,230 --> 00:31:23,760

so are any any utica naturalist from the

766

00:31:29,830 --> 00:31:26,240

19th century or

767

00:31:32,149 --> 00:31:29,840

a physicist or everybody where have some

768

00:31:34,310 --> 00:31:32,159

some knowledge and some understanding

769

00:31:36,630 --> 00:31:34,320

and connection between art and science

770

00:31:39,350 --> 00:31:36,640

they didn't make the difference so from

771

00:31:41,830 --> 00:31:39,360

your own perspective as artists writer

772

00:31:44,950 --> 00:31:41,840

musicians how do you see that today i

773

00:31:46,470 --> 00:31:44,960

know that since the 19th century century

774

00:31:50,149 --> 00:31:46,480

sorry we tend to

775

00:31:51,990 --> 00:31:50,159

uh specialize and dissociate the fields

776

00:31:53,190 --> 00:31:52,000

and become more and more between

777

00:31:56,710 --> 00:31:53,200

brackets

778

00:32:00,149 --> 00:31:56,720

robotic and technical and virtual also

779

00:32:01,990 --> 00:32:00,159

let's say in our own field but

780

00:32:03,590 --> 00:32:02,000

do you see that this tendency will come

781

00:32:05,750 --> 00:32:03,600

back of this

782

00:32:07,990 --> 00:32:05,760

enlightenment kind of period that went

783

00:32:10,549 --> 00:32:08,000

up to the 19 or not

784

00:32:12,149 --> 00:32:10,559

and the request later request um first

785

00:32:14,870 --> 00:32:12,159

for the

786

00:32:18,389 --> 00:32:14,880

the great dancer here

787

00:32:20,870 --> 00:32:18,399

i am an aficionado um and i i can get

788

00:32:22,070 --> 00:32:20,880

the dwindly sometimes but i'm not a

789

00:32:25,190 --> 00:32:22,080

narcissist

790

00:32:26,070 --> 00:32:25,200

so um it reminds me the geometry thing

791

00:32:28,710 --> 00:32:26,080

of

792

00:32:31,669 --> 00:32:28,720

something unrelated to flamenco but from

793

00:32:33,190 --> 00:32:31,679

arnet coleman uh when he when he used

794

00:32:35,430 --> 00:32:33,200

the free jazz

795

00:32:37,350 --> 00:32:35,440

as uh as a

796

00:32:40,630 --> 00:32:37,360

as a way to

797

00:32:42,789 --> 00:32:40,640

to build uh geometrical music and maybe

798

00:32:46,389 --> 00:32:42,799

it could be also way to

799

00:32:49,110 --> 00:32:46,399

to to to talk about geometry uh in in

800

00:32:52,230 --> 00:32:49,120

music and my request is that

801
00:32:55,669 --> 00:32:52,240
you have a a stage that can resonate and

802
00:32:57,990 --> 00:32:55,679
i hope you have good shoes and if we can

803
00:33:01,190 --> 00:32:58,000
put a little bit of buleria maybe you

804
00:33:03,430 --> 00:33:01,200
can show us few steps that will be great

805
00:33:16,870 --> 00:33:03,440
to hear you i would love to

806
00:33:20,549 --> 00:33:17,990
the

807
00:33:21,909 --> 00:33:20,559
tradition tradition says that uh

808
00:33:23,909 --> 00:33:21,919
the arts

809
00:33:26,470 --> 00:33:23,919
were uh

810
00:33:28,549 --> 00:33:26,480
joining the arts and the sciences

811
00:33:31,509 --> 00:33:28,559
was attempted by a man

812
00:33:32,950 --> 00:33:31,519
who published a magazine called amazing

813
00:33:34,789 --> 00:33:32,960

his name was

814

00:33:36,310 --> 00:33:34,799

hugo gernsbach

815

00:33:37,669 --> 00:33:36,320

and it was in the

816

00:33:40,710 --> 00:33:37,679

when was that

817

00:33:41,909 --> 00:33:40,720

60s before my before my birth

818

00:33:43,269 --> 00:33:41,919

uh

819

00:33:45,110 --> 00:33:43,279

sorry

820

00:33:47,430 --> 00:33:45,120

30s 20s

821

00:33:48,630 --> 00:33:47,440

1920s 26 okay

822

00:33:50,230 --> 00:33:48,640

20s

823

00:33:53,110 --> 00:33:50,240

uh

824

00:33:54,630 --> 00:33:53,120

that that this the stories weren't

825

00:33:56,789 --> 00:33:54,640

always perfect

826
00:34:03,590 --> 00:33:56,799
they weren't always good

827
00:34:08,550 --> 00:34:05,590
well just just i i

828
00:34:10,310 --> 00:34:08,560
give one argument in favor of

829
00:34:12,790 --> 00:34:10,320
integrating them i think is that

830
00:34:15,270 --> 00:34:12,800
creativity is a muscle

831
00:34:17,750 --> 00:34:15,280
uh if you if you do creative work it's

832
00:34:19,510 --> 00:34:17,760
going to spread into everything you do i

833
00:34:22,310 --> 00:34:19,520
think if you don't have creativity you

834
00:34:23,909 --> 00:34:22,320
may be really good with your you may get

835
00:34:26,149 --> 00:34:23,919
straight a's all the way through college

836
00:34:28,470 --> 00:34:26,159
and grad school you may be a good lab

837
00:34:29,750 --> 00:34:28,480
worker you may even be the director of

838
00:34:31,030 --> 00:34:29,760

the lab

839

00:34:32,389 --> 00:34:31,040

but i think the people who make the

840

00:34:34,389 --> 00:34:32,399

breakthroughs

841

00:34:37,190 --> 00:34:34,399

are the ones who

842

00:34:38,790 --> 00:34:37,200

exercise their creativity and or you

843

00:34:40,550 --> 00:34:38,800

know and when they're out walking or

844

00:34:43,190 --> 00:34:40,560

feeding the dog or standing in the

845

00:34:45,270 --> 00:34:43,200

shower they're thinking about okay what

846

00:34:47,270 --> 00:34:45,280

else uh there was a teacher i listened

847

00:34:48,790 --> 00:34:47,280

to today from new zealand uh in a

848

00:34:50,629 --> 00:34:48,800

lecture upstairs she was talking about

849

00:34:52,310 --> 00:34:50,639

how in new zealand the teachers are

850

00:34:54,629 --> 00:34:52,320

trained to think in terms of every

851
00:34:57,670 --> 00:34:54,639
lesson needs to have a what

852
00:35:00,230 --> 00:34:57,680
so what and what next

853
00:35:02,870 --> 00:35:00,240
and i think the arts are are the br the

854
00:35:13,589 --> 00:35:02,880
bridge between what and what next art

855
00:35:16,630 --> 00:35:15,349
i guess like my the two cents i would

856
00:35:18,390 --> 00:35:16,640
add is i mean i don't think i could ever

857
00:35:19,589 --> 00:35:18,400
separate the two uh myself personally

858
00:35:21,750 --> 00:35:19,599
that's why i did

859
00:35:23,109 --> 00:35:21,760
a theater degree and a biology degree

860
00:35:26,150 --> 00:35:23,119
and

861
00:35:27,109 --> 00:35:26,160
like luckily that panned out all right

862
00:35:28,390 --> 00:35:27,119
but

863
00:35:30,069 --> 00:35:28,400

yeah i think i think and i think that

864

00:35:31,109 --> 00:35:30,079

the reasons i was interested in art are

865

00:35:32,870 --> 00:35:31,119

kind of the same reasons i was

866

00:35:33,670 --> 00:35:32,880

interested in science it's the question

867

00:35:34,550 --> 00:35:33,680

of

868

00:35:36,150 --> 00:35:34,560

you know

869

00:35:37,349 --> 00:35:36,160

what is this why are we here what are we

870

00:35:39,910 --> 00:35:37,359

you know what are we doing that that

871

00:35:41,270 --> 00:35:39,920

sort of those sort of questions and

872

00:35:52,710 --> 00:35:41,280

and

873

00:35:55,910 --> 00:35:52,720

to find answers or solve problems that

874

00:35:58,470 --> 00:35:55,920

the creativity is is a it's a process

875

00:35:59,270 --> 00:35:58,480

and when focusing on the process we get

876

00:36:01,750 --> 00:35:59,280

to

877

00:36:05,510 --> 00:36:01,760

the the breakthroughs as you mentioned

878

00:36:07,750 --> 00:36:05,520

there and um and in in terms of putting

879

00:36:09,030 --> 00:36:07,760

putting you know the arts and and

880

00:36:12,310 --> 00:36:09,040

science and

881

00:36:14,630 --> 00:36:12,320

back together um to to look at an

882

00:36:16,550 --> 00:36:14,640

artistic practice um

883

00:36:19,190 --> 00:36:16,560

with the same lens that you look at the

884

00:36:20,950 --> 00:36:19,200

scientific method um to put those two

885

00:36:22,950 --> 00:36:20,960

back on the same track will help to

886

00:36:26,790 --> 00:36:22,960

bring these back together i think it can

887

00:36:31,589 --> 00:36:27,670

um

888

00:36:32,790 --> 00:36:31,599

i'm an author and i write uh genre

889

00:36:34,470 --> 00:36:32,800

fiction

890

00:36:35,270 --> 00:36:34,480

and

891

00:36:37,349 --> 00:36:35,280

my

892

00:36:41,030 --> 00:36:37,359

primary motivation in writing is to

893

00:36:43,190 --> 00:36:41,040

entertain like that's that's the first

894

00:36:46,310 --> 00:36:43,200

thing that i want i want people to enjoy

895

00:36:47,190 --> 00:36:46,320

the the writing and listening to

896

00:36:51,109 --> 00:36:47,200

you

897

00:36:53,910 --> 00:36:51,119

trying to

898

00:36:56,150 --> 00:36:53,920

um educate primarily

899

00:36:57,910 --> 00:36:56,160

first and foremost

900

00:36:59,910 --> 00:36:57,920

is really interesting to me but it

901
00:37:02,950 --> 00:36:59,920
sounds to me

902
00:37:05,750 --> 00:37:02,960
very restrictive very constrictive and i

903
00:37:07,270 --> 00:37:05,760
wondered if you

904
00:37:09,589 --> 00:37:07,280
if it feels that way to you if you're

905
00:37:11,190 --> 00:37:09,599
like no i really want to just

906
00:37:13,670 --> 00:37:11,200
go off and

907
00:37:16,710 --> 00:37:13,680
and do like maybe take this core of an

908
00:37:19,349 --> 00:37:16,720
idea but then write it completely

909
00:37:20,230 --> 00:37:19,359
separate story that it isn't about this

910
00:37:24,550 --> 00:37:20,240
thing

911
00:37:25,990 --> 00:37:24,560
um or if having this core idea of

912
00:37:27,589 --> 00:37:26,000
education

913
00:37:29,750 --> 00:37:27,599

uh is

914

00:37:31,430 --> 00:37:29,760

um if you don't feel it's constrictive

915

00:37:34,310 --> 00:37:31,440

if you feel somehow freeing i'm

916

00:37:37,910 --> 00:37:35,670

yeah

917

00:37:39,910 --> 00:37:37,920

i was gonna uh

918

00:37:41,750 --> 00:37:39,920

take a stab at that um while everyone

919

00:37:43,750 --> 00:37:41,760

else falls um i think that's an

920

00:37:47,190 --> 00:37:43,760

interesting idea and i will say that my

921

00:37:50,230 --> 00:37:47,200

plays are 100 not educational

922

00:37:51,829 --> 00:37:50,240

but there's always a message and um and

923

00:37:53,190 --> 00:37:51,839

so i think this is an interesting thing

924

00:37:55,910 --> 00:37:53,200

for us to

925

00:37:57,750 --> 00:37:55,920

uh consider uh like what is that

926

00:38:00,069 --> 00:37:57,760

fundamental difference what makes a

927

00:38:02,470 --> 00:38:00,079

message somehow suddenly informational

928

00:38:04,790 --> 00:38:02,480

or educational you know just learning

929

00:38:05,990 --> 00:38:04,800

about the a world that someone else

930

00:38:07,109 --> 00:38:06,000

lived in

931

00:38:10,150 --> 00:38:07,119

um

932

00:38:12,069 --> 00:38:10,160

can be either a message or educational

933

00:38:13,510 --> 00:38:12,079

and i think it

934

00:38:15,270 --> 00:38:13,520

that's interest that's a really

935

00:38:17,670 --> 00:38:15,280

interesting idea that you're talking

936

00:38:19,589 --> 00:38:17,680

about and i think it just has to do with

937

00:38:21,030 --> 00:38:19,599

like what what was the thing you wanted

938

00:38:23,670 --> 00:38:21,040

someone to take away do you want them to

939

00:38:25,589 --> 00:38:23,680

be able to repeat some sort of process

940

00:38:28,310 --> 00:38:25,599

or or understanding something about the

941

00:38:33,750 --> 00:38:28,320

world or just be able to imagine the

942

00:38:39,430 --> 00:38:37,349

and i would also say um

943

00:38:41,190 --> 00:38:39,440

i'd like there is that balance between

944

00:38:44,829 --> 00:38:41,200

education and communication and i think

945

00:38:48,630 --> 00:38:47,510

and sometimes maybe maybe if you're

946

00:38:50,069 --> 00:38:48,640

doing it

947

00:38:51,829 --> 00:38:50,079

in a traditional like for traditional

948

00:38:52,870 --> 00:38:51,839

education like in the classroom and that

949

00:38:54,310 --> 00:38:52,880

sort of thing

950

00:38:55,750 --> 00:38:54,320

it's more about knowing your audience

951
00:38:56,630 --> 00:38:55,760
and knowing how to communicate with them

952
00:38:58,310 --> 00:38:56,640
and

953
00:39:00,870 --> 00:38:58,320
you could look at that as a constraint

954
00:39:02,310 --> 00:39:00,880
but also that's like sometimes

955
00:39:04,550 --> 00:39:02,320
constraints

956
00:39:06,470 --> 00:39:04,560
push you into into finding really cool

957
00:39:08,470 --> 00:39:06,480
solutions you know and

958
00:39:10,870 --> 00:39:08,480
push your creativity and and allow you

959
00:39:13,190 --> 00:39:10,880
to kind of create even more so i i don't

960
00:39:14,390 --> 00:39:13,200
see it as a constraint personally

961
00:39:15,589 --> 00:39:14,400
and there is art that you create for

962
00:39:16,870 --> 00:39:15,599
yourself and

963
00:39:18,390 --> 00:39:16,880

sometimes it's just good to scream into

964

00:39:19,990 --> 00:39:18,400

the void and not care who's who's going

965

00:39:21,190 --> 00:39:20,000

to hear it but you know

966

00:39:22,390 --> 00:39:21,200

um

967

00:39:24,230 --> 00:39:22,400

sometimes when you when you have a

968

00:39:25,589 --> 00:39:24,240

message you want to communicate it's it

969

00:39:32,390 --> 00:39:25,599

actually kind of

970

00:39:37,190 --> 00:39:35,510

thank you thank you

971

00:39:38,710 --> 00:39:37,200

hi thanks very much for convening the

972

00:39:42,550 --> 00:39:38,720

panel my name is dan lapin with

973

00:39:44,069 --> 00:39:42,560

enterogenesis designs and the

974

00:39:46,150 --> 00:39:44,079

uh oh

975

00:39:48,069 --> 00:39:46,160

am i still on yeah so the first thing

976

00:39:50,069 --> 00:39:48,079

i'd like to ask is how could we get

977

00:39:51,030 --> 00:39:50,079

three men who are both all flamenco

978

00:39:52,790 --> 00:39:51,040

dancers

979

00:39:54,630 --> 00:39:52,800

uh in a science conference

980

00:39:57,190 --> 00:39:54,640

what's going on with this huh

981

00:39:58,630 --> 00:39:57,200

harvard down here university of chicago

982

00:40:00,069 --> 00:39:58,640

yeah and so i think that's really

983

00:40:01,109 --> 00:40:00,079

curious but i think part of it is the

984

00:40:04,069 --> 00:40:01,119

point of

985

00:40:06,630 --> 00:40:04,079

of the physicality of some arts brings

986

00:40:08,230 --> 00:40:06,640

the quality of the biology of life force

987

00:40:09,510 --> 00:40:08,240

and i think in an astrobiology

988

00:40:10,950 --> 00:40:09,520

conference that's really really

989

00:40:12,390 --> 00:40:10,960

important as we look at cellular

990

00:40:14,710 --> 00:40:12,400

structures that have energy systems

991

00:40:16,950 --> 00:40:14,720

themselves okay we're looking at primary

992

00:40:18,790 --> 00:40:16,960

life force and you know i don't know how

993

00:40:20,710 --> 00:40:18,800

long we've been trying for scientists to

994

00:40:22,790 --> 00:40:20,720

put life in a box

995

00:40:25,829 --> 00:40:22,800

but i think the arts and the humanities

996

00:40:27,990 --> 00:40:25,839

for millennium have been you know how do

997

00:40:30,390 --> 00:40:28,000

we all the way back to the gymnasiums of

998

00:40:32,790 --> 00:40:30,400

greek greece you know how do we embody

999

00:40:35,990 --> 00:40:32,800

with the fullness of our soma okay

1000

00:40:37,990 --> 00:40:36,000

versus a trend in cognition okay and the

1001

00:40:39,670 --> 00:40:38,000

central nervous system itself i think

1002

00:40:41,510 --> 00:40:39,680

it's a really important point of how we

1003

00:40:44,069 --> 00:40:41,520

look at the anatomy and physiology of

1004

00:40:45,829 --> 00:40:44,079

our arts and our sciences with that and

1005

00:40:47,829 --> 00:40:45,839

so my question both to the panel and

1006

00:40:49,910 --> 00:40:47,839

also to the audience here

1007

00:40:52,550 --> 00:40:49,920

is are people think you know so what are

1008

00:40:55,270 --> 00:40:52,560

people doing within their labs

1009

00:40:59,829 --> 00:40:55,280

to to bring artistic metaphors or

1010

00:41:02,150 --> 00:40:59,839

artistic examples into daily practices

1011

00:41:03,910 --> 00:41:02,160

into how to make it physical so that we

1012

00:41:05,990 --> 00:41:03,920

we integrate between our right and left

1013

00:41:08,150 --> 00:41:06,000

hemisphere between our head and our

1014

00:41:10,630 --> 00:41:08,160

bodies to bring forth that that

1015

00:41:12,550 --> 00:41:10,640

fundamental internal inquiry process

1016

00:41:13,990 --> 00:41:12,560

so i'm curious for the panel to comment

1017

00:41:15,910 --> 00:41:14,000

but if anyone else has some ideas about

1018

00:41:22,150 --> 00:41:15,920

that i'm actively working in that area

1019

00:41:25,750 --> 00:41:23,829

i don't move

1020

00:41:28,230 --> 00:41:25,760

i have a friend who practices her

1021

00:41:30,950 --> 00:41:28,240

flamenco pastors in the lab while she

1022

00:41:32,230 --> 00:41:30,960

does her slides

1023

00:41:33,750 --> 00:41:32,240

i think i think we've learned that next

1024

00:41:36,870 --> 00:41:33,760

step psycho i'm going to have a flamenco

1025

00:41:45,510 --> 00:41:38,309

yes who knew

1026
00:41:54,870 --> 00:41:49,510
anybody in the audience have any ideas

1027
00:42:00,550 --> 00:41:57,589
abigail oops abigail johnson georgia

1028
00:42:04,870 --> 00:42:00,560
tech you could put musical notes along

1029
00:42:08,309 --> 00:42:07,190
okay how many how many people

1030
00:42:10,150 --> 00:42:08,319
i was gonna have like how many people

1031
00:42:11,750 --> 00:42:10,160
listen like if you work in a lab like

1032
00:42:12,950 --> 00:42:11,760
have like listen to music while you're

1033
00:42:15,109 --> 00:42:12,960
working

1034
00:42:17,270 --> 00:42:15,119
i mean i always yeah

1035
00:42:19,510 --> 00:42:17,280
and maybe i'm not quite consciously

1036
00:42:21,670 --> 00:42:19,520
doing it but yeah for sure when i was i

1037
00:42:22,870 --> 00:42:21,680
remember like working in an anaerobic

1038
00:42:24,390 --> 00:42:22,880

chamber and having my hands and the

1039

00:42:25,109 --> 00:42:24,400

gloves for like eight hours at a time

1040

00:42:27,190 --> 00:42:25,119

and

1041

00:42:28,390 --> 00:42:27,200

you have to you know your back would

1042

00:42:29,670 --> 00:42:28,400

give out if you weren't moving around a

1043

00:42:31,670 --> 00:42:29,680

bit and stuff but i don't think i ever

1044

00:42:32,870 --> 00:42:31,680

kind of consciously thought about those

1045

00:42:34,230 --> 00:42:32,880

kinds of the connections that you were

1046

00:42:38,950 --> 00:42:34,240

talking about yeah i'm going to be

1047

00:42:44,870 --> 00:42:41,829

just a little maybe a comment i

1048

00:42:46,790 --> 00:42:44,880

i grew up my uh you know like kind of

1049

00:42:47,670 --> 00:42:46,800

arts environments

1050

00:42:50,470 --> 00:42:47,680

uh

1051
00:42:52,230 --> 00:42:50,480
many many ideas if you go just back to

1052
00:42:58,630 --> 00:42:52,240
the

1053
00:43:00,309 --> 00:42:58,640
discussing concepts

1054
00:43:03,190 --> 00:43:00,319
and those concepts if you take like for

1055
00:43:05,030 --> 00:43:03,200
example just cubism by by itself and the

1056
00:43:08,309 --> 00:43:05,040
conversation that you will have between

1057
00:43:11,349 --> 00:43:08,319
picasso or modigliani etc these are

1058
00:43:14,150 --> 00:43:11,359
really concepts that deals with geometry

1059
00:43:15,750 --> 00:43:14,160
that's about perception about with so

1060
00:43:17,829 --> 00:43:15,760
many different aspects that the

1061
00:43:20,309 --> 00:43:17,839
scientists will take over and they can

1062
00:43:22,550 --> 00:43:20,319
have a real conversation with physicists

1063
00:43:24,790 --> 00:43:22,560

and with mathematicians and did it did

1064

00:43:26,950 --> 00:43:24,800

happen in the past and it still happened

1065

00:43:29,589 --> 00:43:26,960

and i think there is uh

1066

00:43:32,230 --> 00:43:29,599

when i ask the question is is uh and

1067

00:43:34,309 --> 00:43:32,240

it's related to yours it's we

1068

00:43:38,069 --> 00:43:34,319

there is this connection it's just the

1069

00:43:39,990 --> 00:43:38,079

tendency in your daily life job you are

1070

00:43:42,230 --> 00:43:40,000

uh

1071

00:43:46,790 --> 00:43:42,240

you have to be like have a kind of a

1072

00:43:50,069 --> 00:43:46,800

speciality but in in in overall the arts

1073

00:43:52,150 --> 00:43:50,079

is a principal component of of of

1074

00:43:55,030 --> 00:43:52,160

science and it should be

1075

00:43:57,990 --> 00:43:55,040

like that and we should teach more arts

1076

00:44:04,630 --> 00:43:58,000

within science uh for science

1077

00:44:12,069 --> 00:44:06,870

i'd add to that petition to add musical

1078

00:44:15,670 --> 00:44:14,470

my name is annelise meyer i'm from mit

1079

00:44:16,550 --> 00:44:15,680

hui

1080

00:44:18,710 --> 00:44:16,560

and

1081

00:44:21,030 --> 00:44:18,720

we've heard a lot among the panelists

1082

00:44:22,710 --> 00:44:21,040

about kind of how we can use these

1083

00:44:25,190 --> 00:44:22,720

arts and music to

1084

00:44:26,950 --> 00:44:25,200

reach across age demographics

1085

00:44:29,030 --> 00:44:26,960

i'd be interested to hear more about

1086

00:44:30,790 --> 00:44:29,040

either examples of what you have done or

1087

00:44:33,109 --> 00:44:30,800

what you would hope to do to reach

1088

00:44:34,230 --> 00:44:33,119

across race gender and sexuality

1089

00:44:35,910 --> 00:44:34,240

dynamics

1090

00:44:38,790 --> 00:44:35,920

demographics because i feel like arts

1091

00:44:41,109 --> 00:44:38,800

probably has a huge

1092

00:44:48,230 --> 00:44:41,119

opportunity to bring science to a range

1093

00:44:54,150 --> 00:44:51,750

um uh i will

1094

00:44:56,870 --> 00:44:54,160

try to approach that by saying um most

1095

00:44:58,950 --> 00:44:56,880

of the plays that i've written have been

1096

00:45:00,790 --> 00:44:58,960

performed and staged by

1097

00:45:03,589 --> 00:45:00,800

america's oldest african-american

1098

00:45:06,069 --> 00:45:03,599

theater arts group in baltimore uh the

1099

00:45:07,270 --> 00:45:06,079

arena theater i'm so proud to be able to

1100

00:45:08,790 --> 00:45:07,280

work with them

1101
00:45:11,589 --> 00:45:08,800
and um

1102
00:45:13,990 --> 00:45:11,599
just top quality top quality people and

1103
00:45:18,550 --> 00:45:14,000
and so i think that you know

1104
00:45:20,870 --> 00:45:18,560
it was really great to be able to uh

1105
00:45:22,950 --> 00:45:20,880
as a scientist and artist uh work in

1106
00:45:24,710 --> 00:45:22,960
that community and i felt so honored and

1107
00:45:27,270 --> 00:45:24,720
i don't know if that qualifies as an

1108
00:45:28,390 --> 00:45:27,280
answer to your question but you know i

1109
00:45:30,790 --> 00:45:28,400
think it's just something that you have

1110
00:45:32,710 --> 00:45:30,800
to make part of your practice you know

1111
00:45:34,470 --> 00:45:32,720
we can think about grand plans for these

1112
00:45:37,990 --> 00:45:34,480
things or we can think about solutions

1113
00:45:40,710 --> 00:45:38,000

that i as an artist or scientist can

1114

00:45:43,910 --> 00:45:40,720

make part of my own practice to to build

1115

00:45:47,430 --> 00:45:43,920

those bridges myself

1116

00:45:49,670 --> 00:45:47,440

uh i i would argue to some degree

1117

00:45:52,150 --> 00:45:49,680

the arts one of their strengths is they

1118

00:45:55,349 --> 00:45:52,160

help us get into the heads of people

1119

00:45:56,790 --> 00:45:55,359

outside our own experience

1120

00:45:58,630 --> 00:45:56,800

and uh that's you know part of the

1121

00:46:00,870 --> 00:45:58,640

appeal of science fiction for example or

1122

00:46:03,030 --> 00:46:00,880

you know i think we we can

1123

00:46:06,630 --> 00:46:03,040

look through other people's eyes we can

1124

00:46:08,309 --> 00:46:06,640

experience their story to some degree

1125

00:46:11,349 --> 00:46:08,319

but also

1126
00:46:14,230 --> 00:46:11,359
as a storyteller and musician i want to

1127
00:46:17,270 --> 00:46:14,240
be wary of cultural appropriation

1128
00:46:19,589 --> 00:46:17,280
i i there there are certain lines where

1129
00:46:22,230 --> 00:46:19,599
i want to be careful about crossing them

1130
00:46:24,470 --> 00:46:22,240
and the answer there is collaboration

1131
00:46:25,990 --> 00:46:24,480
so i make a point of reaching out to

1132
00:46:28,710 --> 00:46:26,000
people whose life experience is

1133
00:46:31,510 --> 00:46:28,720
different from my own and it are there

1134
00:46:33,430 --> 00:46:31,520
ways we can work together or just

1135
00:46:35,670 --> 00:46:33,440
invite them to submit their work and

1136
00:46:37,109 --> 00:46:35,680
include it in the library that i run on

1137
00:46:39,270 --> 00:46:37,119
my website because because the main

1138
00:46:42,230 --> 00:46:39,280

thing i do through my non-profit is we

1139

00:46:43,750 --> 00:46:42,240

have a library of teaching songs for

1140

00:46:45,349 --> 00:46:43,760

mainly for kindergarten to eighth grade

1141

00:46:47,430 --> 00:46:45,359

but also some high school and college

1142

00:46:50,309 --> 00:46:47,440

stuff and we're trying to turn it into

1143

00:46:52,710 --> 00:46:50,319

more than just the tim griffin show

1144

00:46:55,030 --> 00:46:52,720

we need people of of every kind of

1145

00:46:57,829 --> 00:46:55,040

experience to share their stories

1146

00:46:59,270 --> 00:46:57,839

through music if we're gonna really be

1147

00:47:01,510 --> 00:46:59,280

fully inclusive because there's there's

1148

00:47:02,230 --> 00:47:01,520

some kinds of stories where i can't tell

1149

00:47:06,630 --> 00:47:02,240

it

1150

00:47:09,030 --> 00:47:06,640

probably wouldn't happen but even if i

1151

00:47:11,589 --> 00:47:09,040

did it still would sound a little weird

1152

00:47:13,910 --> 00:47:11,599

coming from a guy who is born into every

1153

00:47:17,990 --> 00:47:13,920

kind of privilege to be singing about

1154

00:47:22,150 --> 00:47:20,309

yeah

1155

00:47:23,430 --> 00:47:22,160

i'd like to get this said

1156

00:47:26,710 --> 00:47:23,440

the uh

1157

00:47:29,589 --> 00:47:26,720

what what we storytellers do is we

1158

00:47:32,069 --> 00:47:29,599

follow the sciences scientists around

1159

00:47:33,589 --> 00:47:32,079

the scientists the mathematicians uh

1160

00:47:35,430 --> 00:47:33,599

they're the leaders

1161

00:47:36,309 --> 00:47:35,440

uh we look for the

1162

00:47:38,870 --> 00:47:36,319

uh

1163

00:47:40,549 --> 00:47:38,880

interesting things that that could could

1164

00:47:45,910 --> 00:47:40,559

generate stories

1165

00:47:52,790 --> 00:47:49,990

so um go with me here with the work in

1166

00:47:54,870 --> 00:47:52,800

with the ellipse that i have done i've

1167

00:47:57,829 --> 00:47:54,880

looked at these foci and i've looked at

1168

00:48:00,230 --> 00:47:57,839

this rhythmic idea of contour tiempo and

1169

00:48:02,870 --> 00:48:00,240

i've followed it into the african

1170

00:48:05,270 --> 00:48:02,880

diaspora and kind of fallen into

1171

00:48:07,910 --> 00:48:05,280

a group of people who

1172

00:48:09,109 --> 00:48:07,920

research the roots of flamenco in the

1173

00:48:13,270 --> 00:48:09,119

diaspora

1174

00:48:15,589 --> 00:48:13,280

and in atlanta um well and

1175

00:48:19,349 --> 00:48:15,599

through my research i found that there

1176

00:48:23,349 --> 00:48:19,359

is a shared common um root if you will

1177

00:48:26,230 --> 00:48:23,359

um between flamenco and a lot of the the

1178

00:48:27,430 --> 00:48:26,240

rhythms and dances and musics of the

1179

00:48:28,230 --> 00:48:27,440

diaspora

1180

00:48:31,990 --> 00:48:28,240

and

1181

00:48:33,670 --> 00:48:32,000

um

1182

00:48:36,150 --> 00:48:33,680

my work with mathematics in motion here

1183

00:48:38,470 --> 00:48:36,160

in atlanta included um

1184

00:48:41,190 --> 00:48:38,480

an exploration between hip-hop and

1185

00:48:44,230 --> 00:48:41,200

flamenco to find where we could discover

1186

00:48:47,030 --> 00:48:44,240

um common points and differences um and

1187

00:48:51,589 --> 00:48:47,040

then use that as a metaphor um for a

1188

00:48:55,670 --> 00:48:51,599

community and so this is a way in the

1189

00:48:58,870 --> 00:48:55,680

southern u.s that we have begun to

1190

00:48:59,990 --> 00:48:58,880

put flamenco in the seat of activism if

1191

00:49:02,470 --> 00:49:00,000

you will

1192

00:49:03,270 --> 00:49:02,480

to try to get to some of these ideas

1193

00:49:04,710 --> 00:49:03,280

about

1194

00:49:09,829 --> 00:49:04,720

inclusion and

1195

00:49:09,839 --> 00:49:13,990

thank you

1196

00:49:19,270 --> 00:49:16,790

hi uh tim livengood goddard space flight

1197

00:49:21,030 --> 00:49:19,280

center and university of maryland and

1198

00:49:23,910 --> 00:49:21,040

and i just want to disagree a little bit

1199

00:49:28,069 --> 00:49:23,920

with larry's modesty a moment ago about

1200

00:49:29,750 --> 00:49:28,079

following science because in my memory

1201

00:49:32,549 --> 00:49:29,760

uh you're one of the first people who is

1202

00:49:35,829 --> 00:49:32,559

taking seriously the idea of inhabited

1203

00:49:37,190 --> 00:49:35,839

planets at red dwarf stars which is now

1204

00:49:40,150 --> 00:49:37,200

something that's becoming really

1205

00:49:43,829 --> 00:49:40,160

important to consider in astrobiology

1206

00:49:46,549 --> 00:49:43,839

but about 15 years ago was crazy talk

1207

00:49:49,030 --> 00:49:46,559

and clearly it would be silly to talk

1208

00:49:52,309 --> 00:49:49,040

about something like that

1209

00:49:54,630 --> 00:49:52,319

i had a paper i did about 10 years ago

1210

00:49:57,589 --> 00:49:54,640

looking at earth from the outside as an

1211

00:50:00,309 --> 00:49:57,599

analog exoplanet in which i managed to

1212

00:50:02,309 --> 00:50:00,319

sneak in a professional reference to

1213

00:50:04,710 --> 00:50:02,319

frank herbert for dune

1214

00:50:06,390 --> 00:50:04,720

uh because of earth's spectrum when you

1215

00:50:08,549 --> 00:50:06,400

look at it in the visible

1216

00:50:11,589 --> 00:50:08,559

and uh only one of the reviewers caught

1217

00:50:14,069 --> 00:50:11,599

it but he said i i will allow it

1218

00:50:15,990 --> 00:50:14,079

but i have two that i'm working on now

1219

00:50:16,790 --> 00:50:16,000

after a long delay that are related to

1220

00:50:18,230 --> 00:50:16,800

that

1221

00:50:20,150 --> 00:50:18,240

one of which

1222

00:50:22,790 --> 00:50:20,160

i came up with a model for something i

1223

00:50:25,190 --> 00:50:22,800

was seeing in my data on the moon and

1224

00:50:28,069 --> 00:50:25,200

about a year after i concocted this i

1225

00:50:30,309 --> 00:50:28,079

was reading a novella by paul anderson

1226
00:50:32,549 --> 00:50:30,319
in one of the shared world collections

1227
00:50:35,589 --> 00:50:32,559
actually the first one

1228
00:50:38,790 --> 00:50:35,599
of the the men kazin wars

1229
00:50:41,910 --> 00:50:38,800
shared world collections and god damn it

1230
00:50:42,790 --> 00:50:41,920
his scenery setting anticipated me by 25

1231
00:50:44,549 --> 00:50:42,800
years

1232
00:50:46,390 --> 00:50:44,559
so the only part of the paper i know for

1233
00:50:48,630 --> 00:50:46,400
sure is going to be in there now is that

1234
00:50:50,790 --> 00:50:48,640
the authors are happy the seed priority

1235
00:50:53,349 --> 00:50:50,800
to the earlier work

1236
00:50:54,069 --> 00:50:53,359
but the other one is i'm working on one

1237
00:50:56,470 --> 00:50:54,079
now

1238
00:50:59,349 --> 00:50:56,480

on observing the earth from its poles as

1239

00:51:01,829 --> 00:50:59,359

a model exoplanet i would love to fit in

1240

00:51:04,710 --> 00:51:01,839

a professional reference to you

1241

00:51:06,549 --> 00:51:04,720

uh referencing the world jinx and i just

1242

00:51:09,270 --> 00:51:06,559

want to know what would you recommend as

1243

00:51:11,589 --> 00:51:09,280

the best source from your work to point

1244

00:51:14,069 --> 00:51:11,599

to for that reference

1245

00:51:15,290 --> 00:51:14,079

okay i've had some

1246

00:51:18,790 --> 00:51:15,300

effect

1247

00:51:20,549 --> 00:51:18,800

[Laughter]

1248

00:51:22,470 --> 00:51:20,559

there's a phrase

1249

00:51:26,069 --> 00:51:22,480

flash mob

1250

00:51:27,270 --> 00:51:26,079

that generated from my flash crowd

1251
00:51:28,470 --> 00:51:27,280
which

1252
00:51:31,430 --> 00:51:28,480
weirdly it's

1253
00:51:33,190 --> 00:51:31,440
it was a story about teleportation

1254
00:51:35,589 --> 00:51:33,200
and uh

1255
00:51:38,230 --> 00:51:35,599
and there isn't any teleportation but it

1256
00:51:41,190 --> 00:51:38,240
still works communication has gotten so

1257
00:51:42,870 --> 00:51:41,200
good that you could generate a mob

1258
00:51:49,270 --> 00:51:42,880
just by having something interesting

1259
00:52:00,870 --> 00:51:53,430
sorry

1260
00:52:05,910 --> 00:52:03,270
but you just gotten active collaboration

1261
00:52:08,069 --> 00:52:05,920
out of this conference larry

1262
00:52:11,109 --> 00:52:08,079
the remark about collaboration

1263
00:52:13,670 --> 00:52:11,119

collaboration is wonderful

1264

00:52:15,589 --> 00:52:13,680

it uh it generates stories

1265

00:52:19,670 --> 00:52:15,599

and and characters

1266

00:52:21,030 --> 00:52:19,680

that would not emerge from a single mind

1267

00:52:28,309 --> 00:52:21,040

and it's a lot

1268

00:52:31,990 --> 00:52:29,510

all righty well we're going to take

1269

00:52:34,230 --> 00:52:32,000

these last two questions and then if

1270

00:52:36,150 --> 00:52:34,240

you'd like to stick around

1271

00:52:37,910 --> 00:52:36,160

we will have a wonderful performance

1272

00:52:40,309 --> 00:52:37,920

here by tim griffin

1273

00:52:42,030 --> 00:52:40,319

and our panelists will also be around if

1274

00:52:43,589 --> 00:52:42,040

you have additional questions

1275

00:52:46,630 --> 00:52:43,599

collaborations

1276

00:52:48,950 --> 00:52:46,640

photos you name it we're here so thank

1277

00:52:53,190 --> 00:52:48,960

you all for your time and we'll move

1278

00:52:58,230 --> 00:52:55,910

hi lydia kivrak university of florida

1279

00:53:00,710 --> 00:52:58,240

how do you feel about astrobiology in

1280

00:53:02,390 --> 00:53:00,720

particular as an avenue for artistic

1281

00:53:05,030 --> 00:53:02,400

expression

1282

00:53:07,829 --> 00:53:05,040

i feel that in particular astrobiology

1283

00:53:10,390 --> 00:53:07,839

is such a almost inherently artistic

1284

00:53:12,390 --> 00:53:10,400

subfield because it is such

1285

00:53:15,109 --> 00:53:12,400

a human question the search for life

1286

00:53:17,910 --> 00:53:15,119

beyond earth and art is also inherently

1287

00:53:22,710 --> 00:53:17,920

very uh human so i just wanted to hear a

1288

00:53:28,470 --> 00:53:25,430

it is amazing how uh

1289

00:53:31,589 --> 00:53:28,480

how how big a crew we can gather to

1290

00:53:36,150 --> 00:53:31,599

discuss astrobiology given that the

1291

00:53:42,470 --> 00:53:40,390

if if an alien if we discover alien life

1292

00:53:45,109 --> 00:53:42,480

it will change everything

1293

00:53:46,309 --> 00:53:45,119

all of the rules we've been laying down

1294

00:53:47,670 --> 00:53:46,319

uh

1295

00:53:52,790 --> 00:53:47,680

will turn out to be

1296

00:53:57,750 --> 00:53:56,309

i was just gonna say that you know um

1297

00:53:59,750 --> 00:53:57,760

i think that

1298

00:54:01,270 --> 00:53:59,760

what's great about astrobiology and and

1299

00:54:03,109 --> 00:54:01,280

science fiction and how i see these

1300

00:54:05,750 --> 00:54:03,119

things coming together is it really is a

1301

00:54:08,150 --> 00:54:05,760

way to just imagine another world

1302

00:54:10,230 --> 00:54:08,160

and you know certainly all of my theater

1303

00:54:13,510 --> 00:54:10,240

art has been very much pretty much about

1304

00:54:15,510 --> 00:54:13,520

this world and and so um

1305

00:54:18,309 --> 00:54:15,520

you know getting to think about the

1306

00:54:21,670 --> 00:54:18,319

possibility space of humanity is

1307

00:54:24,230 --> 00:54:21,680

certainly a refreshing uh aspect of of

1308

00:54:26,390 --> 00:54:24,240

astrobiology and art

1309

00:54:29,270 --> 00:54:26,400

yeah i would say astrobiology is

1310

00:54:30,870 --> 00:54:29,280

incredibly creative and

1311

00:54:32,069 --> 00:54:30,880

a lot of the you know part of that is

1312

00:54:33,510 --> 00:54:32,079

it's so

1313

00:54:34,630 --> 00:54:33,520

there's so many disciplines involved and

1314

00:54:35,829 --> 00:54:34,640

there's so many people from different

1315

00:54:37,510 --> 00:54:35,839

backgrounds and different ways of

1316

00:54:39,430 --> 00:54:37,520

thinking and it takes a lot of

1317

00:54:41,510 --> 00:54:39,440

creativity to work across those kind of

1318

00:54:43,510 --> 00:54:41,520

disciplinary lines that have been you

1319

00:54:46,150 --> 00:54:43,520

know built up over hundreds of years in

1320

00:54:47,670 --> 00:54:46,160

our educational system and to kind of

1321

00:54:49,430 --> 00:54:47,680

break those boundaries and communicate

1322

00:54:50,150 --> 00:54:49,440

with each other and and

1323

00:54:53,190 --> 00:54:50,160

and

1324

00:54:54,470 --> 00:54:53,200

share those ideas um it's also you know

1325

00:54:56,230 --> 00:54:54,480

when you're thinking about the big

1326
00:54:57,829 --> 00:54:56,240
questions about you know the potential

1327
00:54:59,910 --> 00:54:57,839
for life on other planets or the origin

1328
00:55:01,430 --> 00:54:59,920
of life on earth you know we're studying

1329
00:55:03,670 --> 00:55:01,440
what we know we're studying earth as our

1330
00:55:04,549 --> 00:55:03,680
only example and it takes you have to

1331
00:55:05,910 --> 00:55:04,559
when you're trying to take those

1332
00:55:07,750 --> 00:55:05,920
mechanisms that we're learning about on

1333
00:55:09,829 --> 00:55:07,760
earth and extrapolate that to a world

1334
00:55:11,910 --> 00:55:09,839
like mars or other worlds

1335
00:55:13,829 --> 00:55:11,920
it requires creativity and it requires

1336
00:55:15,109 --> 00:55:13,839
imagination um

1337
00:55:16,549 --> 00:55:15,119
and same thing with the origin of life

1338
00:55:18,069 --> 00:55:16,559

you know we're trying to fill gaps in

1339

00:55:19,670 --> 00:55:18,079

knowledge that that

1340

00:55:22,630 --> 00:55:19,680

we have no

1341

00:55:24,549 --> 00:55:22,640

kind of physical evidence to you know

1342

00:55:26,150 --> 00:55:24,559

left up from what we do i guess i mean

1343

00:55:27,910 --> 00:55:26,160

we've got the stuff that's evolved from

1344

00:55:29,190 --> 00:55:27,920

the origin of life but like working back

1345

00:55:31,270 --> 00:55:29,200

down that takes takes a ton of

1346

00:55:31,990 --> 00:55:31,280

creativity

1347

00:55:34,230 --> 00:55:32,000

yeah

1348

00:55:35,109 --> 00:55:34,240

uh tailgating on what aaron said about

1349

00:55:36,470 --> 00:55:35,119

that

1350

00:55:38,789 --> 00:55:36,480

it

1351

00:55:40,109 --> 00:55:38,799

the arts are are such a great way to

1352

00:55:42,630 --> 00:55:40,119

approach this you know

1353

00:55:45,990 --> 00:55:42,640

multi-disciplinary field because again