
NASA SCIENCE LIVE
VIRTUAL EDITION
MODERN-DAY EXPLORERS
SEARCH FOR LIFE
BEYOND
EARTH

1
00:00:20,150 --> 00:00:35,110
[Music]

2
00:00:40,069 --> 00:00:37,110
where do we come from how does life

3
00:00:41,910 --> 00:00:40,079
evolve and is there life beyond earth hi

4
00:00:43,910 --> 00:00:41,920
my name is kelly gerardi and if you've

5
00:00:45,270 --> 00:00:43,920
considered these questions before you're

6
00:00:47,029 --> 00:00:45,280
in good company

7
00:00:49,510 --> 00:00:47,039
while no life beyond earth has been

8
00:00:51,029 --> 00:00:49,520
physically found a multitude of research

9
00:00:53,830 --> 00:00:51,039
has pointed to the possibility of

10
00:00:56,950 --> 00:00:53,840
microbial life microscopic organisms

11
00:00:58,950 --> 00:00:56,960
like bacteria and archaea beyond earth

12
00:01:00,709 --> 00:00:58,960
nasa missions such as perseverance on

13
00:01:02,709 --> 00:01:00,719

mars and even missions that are

14
00:01:04,630 --> 00:01:02,719
exploring remote and extreme places on

15
00:01:07,429 --> 00:01:04,640
earth are starting to uncover the

16
00:01:08,870 --> 00:01:07,439
answers astrobiologists are seeking and

17
00:01:10,630 --> 00:01:08,880
today we're going to speak to the

18
00:01:13,190 --> 00:01:10,640
explorers who have traversed earth's

19
00:01:15,030 --> 00:01:13,200
extreme landscapes providing insights to

20
00:01:16,710 --> 00:01:15,040
the search for life beyond earth but

21
00:01:22,330 --> 00:01:16,720
before we hear from them let's learn a

22
00:02:55,030 --> 00:01:38,650
[Music]

23
00:02:58,630 --> 00:02:57,190
i am so excited today in honor of

24
00:03:01,190 --> 00:02:58,640
women's history month we have an

25
00:03:03,509 --> 00:03:01,200
all-female episode so i am here with dr

26
00:03:05,509 --> 00:03:03,519
darlene lim research scientist at nasa

27
00:03:08,229 --> 00:03:05,519
ames research center and dr jackie

28
00:03:09,910 --> 00:03:08,239
gordial environmental microbiologist at

29
00:03:12,229 --> 00:03:09,920
the university of guelph thank you so

30
00:03:14,630 --> 00:03:12,239
much for being here

31
00:03:16,390 --> 00:03:14,640
thank you thank you for having me

32
00:03:17,910 --> 00:03:16,400
thanks for having us

33
00:03:20,149 --> 00:03:17,920
yeah this is going to be great i'm

34
00:03:22,390 --> 00:03:20,159
excited there's so much to cover so just

35
00:03:26,470 --> 00:03:22,400
to start with the absolute basics can

36
00:03:28,869 --> 00:03:26,480
you tell us what is astrobiology

37
00:03:31,110 --> 00:03:28,879
okay so one way to look at astrobiology

38
00:03:33,750 --> 00:03:31,120

is to start just by breaking down the

39
00:03:35,110 --> 00:03:33,760
word astrobiology so we have astro

40
00:03:37,190 --> 00:03:35,120
meaning star

41
00:03:40,550 --> 00:03:37,200
and biology meaning the study of life

42
00:03:43,430 --> 00:03:40,560
bios is latin for life so astrobiology

43
00:03:46,550 --> 00:03:43,440
is the study of star life it's the

44
00:03:48,470 --> 00:03:46,560
search for life beyond our own planet

45
00:03:51,270 --> 00:03:48,480
and beyond our own solar system in the

46
00:03:54,149 --> 00:03:51,280
universe at large but astrobiology also

47
00:03:56,390 --> 00:03:54,159
concerns itself with the origins of life

48
00:03:59,270 --> 00:03:56,400
on earth how did life start here in the

49
00:04:03,429 --> 00:04:01,429
amazing i know both of you have so much

50
00:04:05,429 --> 00:04:03,439
experience in the field and also with

51
00:04:07,830 --> 00:04:05,439
field research can you share some of

52
00:04:09,429 --> 00:04:07,840
those experiences and tell us what is a

53
00:04:11,190 --> 00:04:09,439
day like in the life of an

54
00:04:12,869 --> 00:04:11,200
astrobiologist darlene maybe we can

55
00:04:15,270 --> 00:04:12,879
start with you

56
00:04:17,189 --> 00:04:15,280
yeah absolutely it's never a dull day

57
00:04:19,030 --> 00:04:17,199
it's always exciting you know both

58
00:04:20,949 --> 00:04:19,040
jackie and i have the privilege of

59
00:04:22,469 --> 00:04:20,959
really doing work that takes us all over

60
00:04:24,070 --> 00:04:22,479
the world as well as into labs in

61
00:04:25,510 --> 00:04:24,080
different different environments where

62
00:04:27,670 --> 00:04:25,520
we have to deal with people every single

63
00:04:29,830 --> 00:04:27,680

day um but some of the places that we do

64
00:04:31,990 --> 00:04:29,840
get to go take us you know into extreme

65
00:04:33,670 --> 00:04:32,000
environments um i've been working most

66
00:04:36,950 --> 00:04:33,680
recently actually in the big island of

67
00:04:38,550 --> 00:04:36,960
hawaii as well as out at sea so um these

68
00:04:40,230 --> 00:04:38,560
are some images from a recent project

69
00:04:42,150 --> 00:04:40,240
called basalt where we were actually

70
00:04:44,230 --> 00:04:42,160
looking at microbial life in volcanic

71
00:04:46,550 --> 00:04:44,240
settings this is some video from a deep

72
00:04:48,870 --> 00:04:46,560
sea hydrothermal vent just off the coast

73
00:04:51,270 --> 00:04:48,880
of where oregon and california meet and

74
00:04:53,189 --> 00:04:51,280
here we have an rov a remotely operated

75
00:04:55,270 --> 00:04:53,199
vehicle deep you know few kilometers

76
00:04:56,870 --> 00:04:55,280
under water actually collecting water

77
00:04:59,110 --> 00:04:56,880
and rock samples and what we do with

78
00:05:00,870 --> 00:04:59,120
those samples is actually examine the

79
00:05:03,029 --> 00:05:00,880
chemistry and then the microbial

80
00:05:04,550 --> 00:05:03,039
populations that are living associated

81
00:05:06,629 --> 00:05:04,560
with the with the water chemistry and

82
00:05:08,870 --> 00:05:06,639
the raw chemistry and we do that so we

83
00:05:10,710 --> 00:05:08,880
can understand life as it pertains to

84
00:05:13,029 --> 00:05:10,720
its you know development here on earth

85
00:05:14,710 --> 00:05:13,039
and how that might also be taking hold

86
00:05:17,110 --> 00:05:14,720
um elsewhere in our solar system and

87
00:05:18,710 --> 00:05:17,120
beyond so it's pretty fun every single

88
00:05:20,390 --> 00:05:18,720

day

89
00:05:23,590 --> 00:05:20,400
that's amazing it looks like a lot of

90
00:05:25,270 --> 00:05:23,600
fun jackie what about you

91
00:05:27,749 --> 00:05:25,280
yeah i want to echo what darlene said

92
00:05:30,070 --> 00:05:27,759
it's it's truly a privilege to get to

93
00:05:32,390 --> 00:05:30,080
see some of these wonderful extreme

94
00:05:34,950 --> 00:05:32,400
sights on our own planet a day in the

95
00:05:37,430 --> 00:05:34,960
field is very busy and it's very

96
00:05:40,230 --> 00:05:37,440
rewarding uh so you're looking at some

97
00:05:42,390 --> 00:05:40,240
photos here of one of my favorite field

98
00:05:45,029 --> 00:05:42,400
sites this is in the mcmurdo dry valleys

99
00:05:47,990 --> 00:05:45,039
of the antarctic it's the coldest and

100
00:05:49,749 --> 00:05:48,000
driest place that we have on our planet

101
00:05:53,110 --> 00:05:49,759
you can see here it just kind of looks

102
00:05:54,629 --> 00:05:53,120
like a barren uh desert wasteland almost

103
00:05:56,710 --> 00:05:54,639
and a day in the field in this

104
00:05:58,950 --> 00:05:56,720
environment is exactly like this photo

105
00:06:02,390 --> 00:05:58,960
here drilling through permafrost this

106
00:06:04,390 --> 00:06:02,400
cold frozen uh you know environment uh

107
00:06:07,189 --> 00:06:04,400
to look for microbial life that may be

108
00:06:08,790 --> 00:06:07,199
surviving or even thriving in these cold

109
00:06:10,950 --> 00:06:08,800
arid soils

110
00:06:13,510 --> 00:06:10,960
this is considered to be a really high

111
00:06:15,590 --> 00:06:13,520
fidelity mars analog mars is a really

112
00:06:16,870 --> 00:06:15,600
cold and dry planet

113
00:06:18,550 --> 00:06:16,880

and so the work that we do in

114
00:06:21,590 --> 00:06:18,560
environments like this

115
00:06:23,510 --> 00:06:21,600
help us know you know how and where we

116
00:06:27,270 --> 00:06:23,520
could potentially look for life on other

117
00:06:29,990 --> 00:06:27,280
planetary bodies such as mars

118
00:06:31,590 --> 00:06:30,000
amazing and speaking of life elsewhere

119
00:06:33,670 --> 00:06:31,600
in the universe what are the other ways

120
00:06:35,749 --> 00:06:33,680
in which nasa is currently searching for

121
00:06:37,909 --> 00:06:35,759
life elsewhere

122
00:06:39,909 --> 00:06:37,919
so i think you can sort of bin it into

123
00:06:41,510 --> 00:06:39,919
three different categories one of them

124
00:06:43,350 --> 00:06:41,520
is as we were just talking about

125
00:06:45,430 --> 00:06:43,360
actually looking to our planet as an

126
00:06:47,510 --> 00:06:45,440
example for for what might exist or

127
00:06:49,990 --> 00:06:47,520
could have existed in the past on other

128
00:06:51,830 --> 00:06:50,000
planets um and so we will actually go

129
00:06:53,589 --> 00:06:51,840
out into these analog field settings as

130
00:06:56,790 --> 00:06:53,599
you see some video here again from

131
00:06:58,390 --> 00:06:56,800
another analog site in idaho and conduct

132
00:07:00,629 --> 00:06:58,400
work that helps us learn about this

133
00:07:03,350 --> 00:07:00,639
planet as well as others and then there

134
00:07:05,189 --> 00:07:03,360
are other things such as missions so

135
00:07:06,950 --> 00:07:05,199
space flight mission ground-based

136
00:07:09,510 --> 00:07:06,960
missions that allow us to observe our

137
00:07:11,670 --> 00:07:09,520
solar system and beyond and understand

138
00:07:13,749 --> 00:07:11,680

the extremities of of you know the

139
00:07:16,469 --> 00:07:13,759
chemistry and the and the habitability

140
00:07:18,070 --> 00:07:16,479
potential of other systems and then

141
00:07:19,830 --> 00:07:18,080
there's sort of a third bin that i would

142
00:07:21,909 --> 00:07:19,840
bring up and that is the laboratory

143
00:07:23,990 --> 00:07:21,919
that's where we can actually move into a

144
00:07:26,309 --> 00:07:24,000
controlled environment and do some very

145
00:07:29,110 --> 00:07:26,319
specific experiments so that we can

146
00:07:30,550 --> 00:07:29,120
really understand um how life might

147
00:07:32,790 --> 00:07:30,560
actually find the potential to

148
00:07:35,110 --> 00:07:32,800
proliferate and take hold and so forth

149
00:07:36,790 --> 00:07:35,120
and how it might actually survive in um

150
00:07:38,550 --> 00:07:36,800
in the extreme conditions of space and

151
00:07:40,469 --> 00:07:38,560
beyond

152
00:07:42,230 --> 00:07:40,479
they're all great examples and we know

153
00:07:44,150 --> 00:07:42,240
so much of this research all space

154
00:07:46,309 --> 00:07:44,160
research in fact starts right here on

155
00:07:47,990 --> 00:07:46,319
earth but why is it important for us to

156
00:07:51,350 --> 00:07:48,000
look inward when we're looking for life

157
00:07:57,029 --> 00:07:54,070
yeah that's a great question so right

158
00:07:58,710 --> 00:07:57,039
now we know of one place that life

159
00:08:01,510 --> 00:07:58,720
exists and it's on our it's in our own

160
00:08:02,950 --> 00:08:01,520
backyard it's our planet here on earth

161
00:08:05,029 --> 00:08:02,960
uh and so we know that life has

162
00:08:08,070 --> 00:08:05,039
originated here on earth and so this is

163
00:08:10,230 --> 00:08:08,080

a great place to start looking we look

164
00:08:12,790 --> 00:08:10,240
at earth to look at you know looking at

165
00:08:14,950 --> 00:08:12,800
the origins of life looking at analog

166
00:08:16,950 --> 00:08:14,960
environments to our own early earth

167
00:08:19,350 --> 00:08:16,960
places like hydrothermal events that

168
00:08:21,670 --> 00:08:19,360
darlene works at but also surface

169
00:08:24,150 --> 00:08:21,680
environments like hot springs or

170
00:08:26,550 --> 00:08:24,160
potential candidates we also look to our

171
00:08:28,790 --> 00:08:26,560
own planet to understand the limits to

172
00:08:30,790 --> 00:08:28,800
life on earth so we look in cold places

173
00:08:34,230 --> 00:08:30,800
to know what the coal's limit of life on

174
00:08:36,070 --> 00:08:34,240
earth is what's the hot limit of life

175
00:08:38,469 --> 00:08:36,080
knowing that the constraints to life

176
00:08:41,029 --> 00:08:38,479
here on our own planet will also help us

177
00:08:43,909 --> 00:08:41,039
constrain where and how we look on other

178
00:08:46,150 --> 00:08:43,919
planetary bodies

179
00:08:47,750 --> 00:08:46,160
amazing i know i'm not the only one with

180
00:08:49,590 --> 00:08:47,760
questions for both of you we have a lot

181
00:08:51,509 --> 00:08:49,600
of people at home who have questions for

182
00:08:53,430 --> 00:08:51,519
our expert guests and we want to hear

183
00:08:55,509 --> 00:08:53,440
them join the conversation and ask your

184
00:08:57,269 --> 00:08:55,519
question by writing in the comment box

185
00:09:00,150 --> 00:08:57,279
wherever you're watching this or using

186
00:09:02,230 --> 00:09:00,160
the hashtag ask nasa on social media so

187
00:09:05,030 --> 00:09:02,240
let's just jump into a few

188
00:09:07,030 --> 00:09:05,040

so our first question is from zoe spikes

189
00:09:09,509 --> 00:09:07,040
on twitter who wants to know what has

190
00:09:11,110 --> 00:09:09,519
been your coolest discovery or what is a

191
00:09:15,509 --> 00:09:11,120
discovery that encourages you to

192
00:09:19,190 --> 00:09:17,350
i have i have one right off the tip of

193
00:09:20,870 --> 00:09:19,200
my head

194
00:09:23,110 --> 00:09:20,880
so that that footage that you saw

195
00:09:25,509 --> 00:09:23,120
earlier in that in that cold desert

196
00:09:29,350 --> 00:09:25,519
environment is also the place of my

197
00:09:31,750 --> 00:09:29,360
coolest discovery uh which is a site on

198
00:09:34,470 --> 00:09:31,760
our own planet where we can't seem to

199
00:09:35,829 --> 00:09:34,480
detect active microbial life happening

200
00:09:38,550 --> 00:09:35,839
right now

201
00:09:40,630 --> 00:09:38,560
so many of you know microorganisms exist

202
00:09:42,790 --> 00:09:40,640
almost everywhere on our planet we have

203
00:09:45,269 --> 00:09:42,800
to try really hard to actually get rid

204
00:09:47,509 --> 00:09:45,279
of them you know we have to sterilize uh

205
00:09:50,150 --> 00:09:47,519
bottles uh etc

206
00:09:53,269 --> 00:09:50,160
and so that that site this really cold

207
00:09:54,150 --> 00:09:53,279
and arid site uh was you know the site

208
00:09:55,670 --> 00:09:54,160
of

209
00:09:57,269 --> 00:09:55,680
you know the first permafrost site on

210
00:09:58,870 --> 00:09:57,279
earth where we couldn't find active

211
00:10:00,550 --> 00:09:58,880
microbial life we knew there were

212
00:10:02,630 --> 00:10:00,560
microbes there because we could see them

213
00:10:05,110 --> 00:10:02,640

with a microscope and we could actually

214
00:10:06,949 --> 00:10:05,120
even sequence their dna

215
00:10:08,790 --> 00:10:06,959
but we couldn't get any hints that they

216
00:10:11,110 --> 00:10:08,800
were actually active and instead it

217
00:10:13,030 --> 00:10:11,120
looked like they were all dormant or you

218
00:10:15,350 --> 00:10:13,040
know in a state that's very similar to

219
00:10:17,990 --> 00:10:15,360
when bears go into hibernation

220
00:10:19,910 --> 00:10:18,000
that discovery led me on a whole rabbit

221
00:10:21,990 --> 00:10:19,920
hole of other environments where

222
00:10:23,269 --> 00:10:22,000
microorganisms that are dormant seem to

223
00:10:25,030 --> 00:10:23,279
be the norm

224
00:10:27,190 --> 00:10:25,040
rather than the exception and that's

225
00:10:31,269 --> 00:10:27,200
really since then the direction that my

226
00:10:33,269 --> 00:10:31,279
my research has been going in

227
00:10:35,350 --> 00:10:33,279
amazing do you want to add anything

228
00:10:37,190 --> 00:10:35,360
darlene

229
00:10:39,829 --> 00:10:37,200
um no i mean first of all i think that's

230
00:10:42,470 --> 00:10:39,839
fantastic and uh every time we go out

231
00:10:44,069 --> 00:10:42,480
you know the the discoveries happen and

232
00:10:45,430 --> 00:10:44,079
sometimes they can be very grand and be

233
00:10:47,350 --> 00:10:45,440
very noticeable and other times it's

234
00:10:48,790 --> 00:10:47,360
sort of a progression and i guess that's

235
00:10:50,870 --> 00:10:48,800
something i just wanted to highlight for

236
00:10:53,430 --> 00:10:50,880
some of our younger viewers out there is

237
00:10:54,710 --> 00:10:53,440
that um it does take time you know to

238
00:10:56,949 --> 00:10:54,720

come to that moment where you're just

239
00:10:58,790 --> 00:10:56,959
like aha and for me

240
00:11:00,949 --> 00:10:58,800
my career has gone from you know

241
00:11:02,550 --> 00:11:00,959
strictly looking at astrobiology related

242
00:11:04,470 --> 00:11:02,560
questions to now moving into science

243
00:11:06,150 --> 00:11:04,480
operations and and some of the projects

244
00:11:08,870 --> 00:11:06,160
that i work on are actually very heavy

245
00:11:10,550 --> 00:11:08,880
around how you organize people so that

246
00:11:12,870 --> 00:11:10,560
we can actually influence flight

247
00:11:14,389 --> 00:11:12,880
missions in real time and so

248
00:11:16,230 --> 00:11:14,399
and actually incorporate science into

249
00:11:18,069 --> 00:11:16,240
those decision-making processes so this

250
00:11:19,829 --> 00:11:18,079
is these are some images of us working

251
00:11:22,790 --> 00:11:19,839
in one of those analog settings where we

252
00:11:24,470 --> 00:11:22,800
incorporate human exploration alongside

253
00:11:25,990 --> 00:11:24,480
and you know closely coupled with

254
00:11:28,150 --> 00:11:26,000
science and we're doing that in

255
00:11:30,069 --> 00:11:28,160
anticipation of missions such as artemis

256
00:11:31,509 --> 00:11:30,079
coming online and of course you know

257
00:11:34,230 --> 00:11:31,519
looking forward in time to when we have

258
00:11:35,990 --> 00:11:34,240
humans exploring the surface of mars so

259
00:11:37,829 --> 00:11:36,000
we're really trying to understand how do

260
00:11:40,069 --> 00:11:37,839
you design systems where you can have

261
00:11:41,829 --> 00:11:40,079
scientists sitting on earth inter you

262
00:11:43,430 --> 00:11:41,839
know interjecting into the process of

263
00:11:45,910 --> 00:11:43,440

discovery and science and that's really

264
00:11:48,790 --> 00:11:45,920
been itself you know a really incredible

265
00:11:51,030 --> 00:11:48,800
process over the last couple of decades

266
00:11:53,190 --> 00:11:51,040
yeah absolutely and speaking of process

267
00:11:55,670 --> 00:11:53,200
i love this next question mason on

268
00:11:58,150 --> 00:11:55,680
facebook wants to know what is nasa's

269
00:12:00,230 --> 00:11:58,160
protocol if there is confirmed contact

270
00:12:03,430 --> 00:12:00,240
with intelligent life who wants to take

271
00:12:06,949 --> 00:12:04,949
um

272
00:12:09,829 --> 00:12:06,959
wow that's it with intelligent life well

273
00:12:11,670 --> 00:12:09,839
that's really interesting um so i do not

274
00:12:13,990 --> 00:12:11,680
speak for nasa in this answer but i will

275
00:12:15,750 --> 00:12:14,000
say there is likely a protocol um i

276
00:12:17,910 --> 00:12:15,760
think a lot of different groups have

277
00:12:19,590 --> 00:12:17,920
ideas on what those protocols should be

278
00:12:22,550 --> 00:12:19,600
um certainly to be friendly would

279
00:12:24,550 --> 00:12:22,560
probably be a good thing uh you know

280
00:12:26,470 --> 00:12:24,560
but um i think everything does come back

281
00:12:28,710 --> 00:12:26,480
to protocol and so um you know the

282
00:12:30,629 --> 00:12:28,720
question totally hits the nail right on

283
00:12:32,790 --> 00:12:30,639
the head and like in that there has to

284
00:12:34,550 --> 00:12:32,800
be preparation and readiness for the for

285
00:12:36,829 --> 00:12:34,560
the opportunity that you know that

286
00:12:40,230 --> 00:12:36,839
present that may present itself in the

287
00:12:41,350 --> 00:12:40,240
future yeah absolutely um later on in

288
00:12:42,550 --> 00:12:41,360

this episode if you're watching i'm

289
00:12:44,230 --> 00:12:42,560
going to ask both of them if they

290
00:12:45,509 --> 00:12:44,240
believe that there is life elsewhere in

291
00:12:47,590 --> 00:12:45,519
the universe so you want to stay tuned

292
00:12:49,590 --> 00:12:47,600
to hear their answers later but next we

293
00:12:51,269 --> 00:12:49,600
have a question from dan on facebook who

294
00:12:52,790 --> 00:12:51,279
wants to know where is the nearest

295
00:12:57,590 --> 00:12:52,800
planet that is most

296
00:13:01,750 --> 00:12:59,350
i actually think

297
00:13:03,910 --> 00:13:01,760
oh well so i was going to say you know i

298
00:13:05,750 --> 00:13:03,920
think mars is the planet next door and

299
00:13:08,150 --> 00:13:05,760
there are a lot of features of mars that

300
00:13:10,790 --> 00:13:08,160
are very similar to earth

301
00:13:11,590 --> 00:13:10,800
but so mars is this cold and dry planet

302
00:13:13,910 --> 00:13:11,600
now

303
00:13:16,069 --> 00:13:13,920
but in the past mars was a little bit

304
00:13:18,470 --> 00:13:16,079
warmer a little bit wetter and a lot

305
00:13:19,590 --> 00:13:18,480
more earth-like than i think many people

306
00:13:22,069 --> 00:13:19,600
think about

307
00:13:24,389 --> 00:13:22,079
so i would say that the planet next door

308
00:13:27,590 --> 00:13:24,399
is is one of the most mars-like

309
00:13:30,389 --> 00:13:27,600
or sorry the most earth-like

310
00:13:32,550 --> 00:13:30,399
definitely and speaking of sort of

311
00:13:33,990 --> 00:13:32,560
earth-like conditions ricky on facebook

312
00:13:36,710 --> 00:13:34,000
wants to hear a little bit more about

313
00:13:38,710 --> 00:13:36,720

conditions on antarctica any thriving

314
00:13:42,870 --> 00:13:38,720
extraordinary life forms that exist in

315
00:13:47,990 --> 00:13:46,230
i can answer this one as well uh so

316
00:13:49,030 --> 00:13:48,000
in in that desert in the mcmurdo dry

317
00:13:49,829 --> 00:13:49,040
valleys

318
00:13:52,389 --> 00:13:49,839
uh

319
00:13:54,949 --> 00:13:52,399
the microorganisms are really the star

320
00:13:56,710 --> 00:13:54,959
of the show uh there isn't bird there

321
00:13:58,949 --> 00:13:56,720
are birds that fly into the area there

322
00:14:01,590 --> 00:13:58,959
aren't plants there's no moss

323
00:14:03,509 --> 00:14:01,600
microorganisms really are are what are

324
00:14:06,949 --> 00:14:03,519
the only life present

325
00:14:09,750 --> 00:14:06,959
one of the coolest life forms uh in this

326
00:14:11,590 --> 00:14:09,760
area are organisms called crypto

327
00:14:13,910 --> 00:14:11,600
endoliths so breaking down that word

328
00:14:15,990 --> 00:14:13,920
crypto means hidden endo means within

329
00:14:18,389 --> 00:14:16,000
and lith means rock and this is

330
00:14:20,790 --> 00:14:18,399
microbial life that's hidden

331
00:14:22,550 --> 00:14:20,800
inside of the rock and you can't see it

332
00:14:24,470 --> 00:14:22,560
from the outside you could walk past one

333
00:14:26,629 --> 00:14:24,480
of these rocks you would never know that

334
00:14:28,069 --> 00:14:26,639
it's teeming with life but if you were

335
00:14:31,030 --> 00:14:28,079
to take a rock hammer

336
00:14:33,670 --> 00:14:31,040
crack it open you would see bright green

337
00:14:36,470 --> 00:14:33,680
bands of photosynthetic organisms that

338
00:14:38,470 --> 00:14:36,480

are using energy from the sun uh to

339
00:14:40,790 --> 00:14:38,480
photosynthesize carbon compounds and

340
00:14:42,629 --> 00:14:40,800
support entire communities of

341
00:14:45,110 --> 00:14:42,639
microorganisms that's exactly what this

342
00:14:46,629 --> 00:14:45,120
photo is is uh it's cracking open one of

343
00:14:48,870 --> 00:14:46,639
these rocks to find the life that's

344
00:14:50,470 --> 00:14:48,880
teeming inside

345
00:14:51,990 --> 00:14:50,480
amazing i know there are a lot more

346
00:14:53,910 --> 00:14:52,000
questions remember you can join the

347
00:14:55,430 --> 00:14:53,920
conversation too ask your question by

348
00:14:57,590 --> 00:14:55,440
writing in the comment box wherever

349
00:14:59,829 --> 00:14:57,600
you're watching this or use the hashtag

350
00:15:01,509 --> 00:14:59,839
ask nasa on social media we will be

351
00:15:03,670 --> 00:15:01,519
right back with darlene and jackie to

352
00:15:05,509 --> 00:15:03,680
answer a few more questions but first

353
00:15:07,350 --> 00:15:05,519
let's take a look at the other ways nasa

354
00:15:10,150 --> 00:15:07,360
explorers are venturing to extreme

355
00:15:13,509 --> 00:15:10,160
environments for science

356
00:15:15,350 --> 00:15:13,519
i am morgan cameron nasa scientist

357
00:15:17,189 --> 00:15:15,360
that's morgan

358
00:15:19,350 --> 00:15:17,199
she's probably one of nasa's best

359
00:15:21,590 --> 00:15:19,360
spokespeople for exploring our solar

360
00:15:24,150 --> 00:15:21,600
system's icy moons europa is a

361
00:15:26,949 --> 00:15:24,160
fascinating place it has this liquid

362
00:15:29,509 --> 00:15:26,959
water ocean that's about three times the

363
00:15:31,350 --> 00:15:29,519

volume of all of earth's oceans combined

364
00:15:33,670 --> 00:15:31,360
that's a lot of water

365
00:15:35,350 --> 00:15:33,680
although europa isn't the only icy moon

366
00:15:37,430 --> 00:15:35,360
in our solar system

367
00:15:39,590 --> 00:15:37,440
nasa has identified it as one of those

368
00:15:40,710 --> 00:15:39,600
places with key astrobiological

369
00:15:43,110 --> 00:15:40,720
potential

370
00:15:45,590 --> 00:15:43,120
morgan is a collaborator on the mapping

371
00:15:47,990 --> 00:15:45,600
imaging spectrometer for europa an

372
00:15:50,150 --> 00:15:48,000
instrument selected for europa clipper

373
00:15:51,269 --> 00:15:50,160
nasa's next mission to jupiter's icy

374
00:15:53,509 --> 00:15:51,279
moon

375
00:15:57,490 --> 00:15:53,519
she's preparing future nasa missions for

376
00:16:00,710 --> 00:15:57,500
success on the surface of alien worlds

377
00:16:03,350 --> 00:16:00,720
[Music]

378
00:16:06,150 --> 00:16:03,360
in 2018 morgan and her colleagues were

379
00:16:09,350 --> 00:16:06,160
in the field studying how life colonizes

380
00:16:11,509 --> 00:16:09,360
in fresh lava earth turns out has a lot

381
00:16:13,509 --> 00:16:11,519
of excellence what we call analog

382
00:16:15,590 --> 00:16:13,519
environments places that are similar

383
00:16:17,910 --> 00:16:15,600
enough to some of these other worlds

384
00:16:20,470 --> 00:16:17,920
that we can conduct some tests and we

385
00:16:22,629 --> 00:16:20,480
can do some analyses here now they're

386
00:16:24,550 --> 00:16:22,639
not perfect of course they're not going

387
00:16:26,710 --> 00:16:24,560
to be exactly like europa but we can

388
00:16:27,829 --> 00:16:26,720

still learn a lot by testing in these

389
00:16:30,550 --> 00:16:27,839
environments

390
00:16:32,069 --> 00:16:30,560
some of these places include antarctica

391
00:16:34,949 --> 00:16:32,079
and the arctic circle but there are

392
00:16:37,670 --> 00:16:34,959
other places too uh alaska greenland

393
00:16:39,030 --> 00:16:37,680
even iceland any place where you have a

394
00:16:40,870 --> 00:16:39,040
lot of ice because guess what the

395
00:16:41,990 --> 00:16:40,880
surface of europa is made of a lot of

396
00:16:44,629 --> 00:16:42,000
ice

397
00:16:46,870 --> 00:16:44,639
we haven't found life beyond earth yet

398
00:16:49,350 --> 00:16:46,880
but there's a growing body of research

399
00:16:51,829 --> 00:16:49,360
that indicates there could be microbial

400
00:16:54,150 --> 00:16:51,839
life in our cosmic neighborhood

401
00:16:56,389 --> 00:16:54,160
morgan and her team make it possible to

402
00:16:57,189 --> 00:16:56,399
both appreciate the life we have here on

403
00:16:59,590 --> 00:16:57,199
earth

404
00:17:07,350 --> 00:16:59,600
and seek new life in our solar system

405
00:17:10,789 --> 00:17:09,110
awesome so we have a ton more questions

406
00:17:12,870 --> 00:17:10,799
as you might expect but before we get to

407
00:17:15,029 --> 00:17:12,880
those i'm wondering how did each of you

408
00:17:17,110 --> 00:17:15,039
get started in these exciting careers

409
00:17:19,270 --> 00:17:17,120
what inspired you to pursue this field

410
00:17:21,029 --> 00:17:19,280
of research darlene maybe we can start

411
00:17:23,189 --> 00:17:21,039
with you

412
00:17:25,510 --> 00:17:23,199
okay thank you for that question um you

413
00:17:27,909 --> 00:17:25,520

know really i have to show my gratitude

414
00:17:29,990 --> 00:17:27,919
towards so many of the women and the men

415
00:17:31,590 --> 00:17:30,000
in my life that have been very gracious

416
00:17:33,190 --> 00:17:31,600
and generous in bringing me into their

417
00:17:35,270 --> 00:17:33,200
world into into the professional

418
00:17:37,350 --> 00:17:35,280
community that i'm now part of and also

419
00:17:39,110 --> 00:17:37,360
for sharing their knowledge with me um

420
00:17:41,029 --> 00:17:39,120
when i was younger and then you know

421
00:17:42,710 --> 00:17:41,039
really nurturing my career as it went

422
00:17:44,390 --> 00:17:42,720
but then if i look even further back in

423
00:17:46,230 --> 00:17:44,400
time you know i have a lot of gratitude

424
00:17:49,270 --> 00:17:46,240
towards my parents who are immigrants to

425
00:17:50,950 --> 00:17:49,280
canada who really wanted to embrace uh

426
00:17:52,870 --> 00:17:50,960
the new country that they just come to

427
00:17:55,029 --> 00:17:52,880
and we spent a lot of time fishing and

428
00:17:57,270 --> 00:17:55,039
camping and just exploring outdoors and

429
00:17:59,350 --> 00:17:57,280
i think that imbued me with the love for

430
00:18:01,430 --> 00:17:59,360
for observation for the natural world

431
00:18:02,789 --> 00:18:01,440
around me um and that of course has

432
00:18:03,830 --> 00:18:02,799
stayed with me to this very day and

433
00:18:06,310 --> 00:18:03,840
that's pretty much what i've made a

434
00:18:07,750 --> 00:18:06,320
career out of so i feel very fortunate

435
00:18:09,750 --> 00:18:07,760
in that realm to have you know moved in

436
00:18:11,590 --> 00:18:09,760
that direction and um have the life i've

437
00:18:14,950 --> 00:18:11,600
had

438
00:18:16,310 --> 00:18:14,960

absolutely jackie what about you

439
00:18:18,789 --> 00:18:16,320
yeah i would say my path into

440
00:18:21,029 --> 00:18:18,799
astrobiology is is one of luck very

441
00:18:23,510 --> 00:18:21,039
similar to darlene i was really really

442
00:18:25,029 --> 00:18:23,520
lucky enough to have great mentors i

443
00:18:27,990 --> 00:18:25,039
actually didn't know that the field of

444
00:18:29,510 --> 00:18:28,000
astrobiology existed until i was an

445
00:18:32,230 --> 00:18:29,520
undergraduate

446
00:18:34,950 --> 00:18:32,240
there were no astrobiology courses at my

447
00:18:38,070 --> 00:18:34,960
school and it wasn't until i happened to

448
00:18:40,390 --> 00:18:38,080
be doing research uh you know micro

449
00:18:42,150 --> 00:18:40,400
microbiology research in polar

450
00:18:45,350 --> 00:18:42,160
environments and i had a mentor who was

451
00:18:47,510 --> 00:18:45,360
very into micro into astrobiology

452
00:18:49,350 --> 00:18:47,520
and these mentors really guided me and

453
00:18:51,350 --> 00:18:49,360
introduced me to this field and i

454
00:18:54,710 --> 00:18:51,360
quickly fell in love with it and and

455
00:18:56,950 --> 00:18:54,720
have been in it ever since

456
00:18:58,630 --> 00:18:56,960
well i am so excited for all of the

457
00:19:01,110 --> 00:18:58,640
folks who will come behind you in this

458
00:19:02,950 --> 00:19:01,120
really exciting field so before we get

459
00:19:04,390 --> 00:19:02,960
into everyone else's questions i just

460
00:19:06,630 --> 00:19:04,400
have to ask

461
00:19:08,150 --> 00:19:06,640
do each of you believe that life exists

462
00:19:10,070 --> 00:19:08,160
elsewhere in the universe i'm just going

463
00:19:11,830 --> 00:19:10,080

to have to put you on the spot yeah i'm

464
00:19:13,350 --> 00:19:11,840
getting nods

465
00:19:16,710 --> 00:19:13,360
yes i think

466
00:19:18,549 --> 00:19:16,720
it up my hypothesis is yes

467
00:19:20,950 --> 00:19:18,559
and you know i think it's getting a lot

468
00:19:22,150 --> 00:19:20,960
of activities right now to try and make

469
00:19:24,310 --> 00:19:22,160
sure that we go out and test that

470
00:19:26,710 --> 00:19:24,320
hypothesis both you know near field and

471
00:19:28,470 --> 00:19:26,720
far field so it's it's the exciting time

472
00:19:30,470 --> 00:19:28,480
to be in planetary science and in

473
00:19:32,710 --> 00:19:30,480
astrobiology

474
00:19:35,110 --> 00:19:32,720
amazing okay so jumping into everyone

475
00:19:37,669 --> 00:19:35,120
else's questions now uh our first one is

476
00:19:40,150 --> 00:19:37,679
from scotty justine on facebook who asks

477
00:19:44,549 --> 00:19:40,160
how much optimism is there about life on

478
00:19:49,590 --> 00:19:47,029
that's an interesting question i think

479
00:19:51,750 --> 00:19:49,600
optimism translates to motivation in the

480
00:19:53,909 --> 00:19:51,760
scientific community so the fact that we

481
00:19:55,750 --> 00:19:53,919
have so many missions currently

482
00:19:57,669 --> 00:19:55,760
operating on mars that have operated on

483
00:19:59,430 --> 00:19:57,679
mars and um you know that just started

484
00:20:01,270 --> 00:19:59,440
operating on mars should give you an

485
00:20:04,310 --> 00:20:01,280
indication as to the amount of

486
00:20:06,470 --> 00:20:04,320
enthusiasm um and energy and motivation

487
00:20:08,070 --> 00:20:06,480
that you know is is just permeating

488
00:20:10,310 --> 00:20:08,080

throughout our community

489
00:20:12,470 --> 00:20:10,320
it's a very exciting landscape to

490
00:20:14,230 --> 00:20:12,480
explore a lot of people have also

491
00:20:16,870 --> 00:20:14,240
thought about this landscape on mars

492
00:20:19,029 --> 00:20:16,880
through the lens of analog work on earth

493
00:20:21,590 --> 00:20:19,039
so there's uh you know a lot of research

494
00:20:23,350 --> 00:20:21,600
that's been done um to get us to this

495
00:20:25,830 --> 00:20:23,360
particular moment in time and i think

496
00:20:27,750 --> 00:20:25,840
we're really seeing a lot of just

497
00:20:29,270 --> 00:20:27,760
enthusiasm around capitalizing on all

498
00:20:31,909 --> 00:20:29,280
the knowledge to date and then trying to

499
00:20:33,750 --> 00:20:31,919
build forward from there so um yeah i

500
00:20:35,830 --> 00:20:33,760
think the answer is it's a good time to

501
00:20:37,750 --> 00:20:35,840
be in this field

502
00:20:39,590 --> 00:20:37,760
for sure and patrick wants to hear a

503
00:20:41,350 --> 00:20:39,600
little bit more what those life forms

504
00:20:43,590 --> 00:20:41,360
could be like do you think that we will

505
00:20:49,190 --> 00:20:43,600
find life that's not carbon-based or

506
00:20:53,590 --> 00:20:51,110
that's that's a great question uh you

507
00:20:56,070 --> 00:20:53,600
know we have astrobiology uh targets

508
00:20:58,950 --> 00:20:56,080
such as titan uh which

509
00:21:02,070 --> 00:20:58,960
you know there are lakes of hydrocarbons

510
00:21:04,870 --> 00:21:02,080
uh could there be life on a place like

511
00:21:06,950 --> 00:21:04,880
titan that uses another solvent uh you

512
00:21:09,230 --> 00:21:06,960
know instead of water as hydrocarbons

513
00:21:11,590 --> 00:21:09,240

and you know these are questions that

514
00:21:12,549 --> 00:21:11,600
astrobiologists are asking and i think

515
00:21:14,950 --> 00:21:12,559
you know

516
00:21:17,270 --> 00:21:14,960
many things are fair game

517
00:21:19,990 --> 00:21:17,280
but as of right now we don't know of any

518
00:21:22,789 --> 00:21:20,000
of these life forms of course

519
00:21:24,630 --> 00:21:22,799
yeah absolutely kuwait on facebook wants

520
00:21:28,870 --> 00:21:24,640
to know where do you think is the best

521
00:21:32,870 --> 00:21:30,470
well i think if we consider within our

522
00:21:35,190 --> 00:21:32,880
solar system and if you're looking to

523
00:21:37,990 --> 00:21:35,200
answer the question from an existing you

524
00:21:39,350 --> 00:21:38,000
know life-form perspective then i would

525
00:21:41,029 --> 00:21:39,360
go to some of the ocean worlds that

526
00:21:43,190 --> 00:21:41,039
we're pretty excited about europa

527
00:21:45,510 --> 00:21:43,200
enceladus as an example jackie just

528
00:21:47,190 --> 00:21:45,520
mentioned titan i think um you know

529
00:21:48,549 --> 00:21:47,200
again when we think about the previous

530
00:21:50,149 --> 00:21:48,559
question around enthusiasm and

531
00:21:51,909 --> 00:21:50,159
motivation there's just so much data

532
00:21:53,990 --> 00:21:51,919
that's been built up we've also had

533
00:21:56,310 --> 00:21:54,000
other you know flight missions that have

534
00:21:58,789 --> 00:21:56,320
gone for example um there's cassini

535
00:22:00,549 --> 00:21:58,799
there's juno that's generating data that

536
00:22:02,310 --> 00:22:00,559
gives us a better sense of how to

537
00:22:05,029 --> 00:22:02,320
strategize and get ourselves ready for

538
00:22:07,029 --> 00:22:05,039

missions that will take us um into you

539
00:22:08,710 --> 00:22:07,039
know these into these environments and

540
00:22:10,870 --> 00:22:08,720
then allow us to really interrogate it

541
00:22:13,110 --> 00:22:10,880
properly to look at the hypothesis of

542
00:22:14,710 --> 00:22:13,120
yes there is life that's existing in our

543
00:22:16,310 --> 00:22:14,720
solar system right now beyond our own

544
00:22:18,710 --> 00:22:16,320
planet

545
00:22:20,390 --> 00:22:18,720
so i know both of you are professionals

546
00:22:22,070 --> 00:22:20,400
and experts in this field but arlene

547
00:22:24,470 --> 00:22:22,080
meter on twitter wants to know do you

548
00:22:26,230 --> 00:22:24,480
have examples of a science fail where

549
00:22:29,909 --> 00:22:26,240
you made a mistake something you can

550
00:22:32,610 --> 00:22:31,750
i think the locker's good right

551
00:22:35,510 --> 00:22:32,620
for everything

552
00:22:36,789 --> 00:22:35,520
[Laughter]

553
00:22:40,390 --> 00:22:36,799
yeah uh

554
00:22:43,110 --> 00:22:40,400
i mean so many that i i can't even count

555
00:22:44,870 --> 00:22:43,120
i have you know just silly mistakes that

556
00:22:47,029 --> 00:22:44,880
i've made of

557
00:22:48,390 --> 00:22:47,039
mislabeling something or making a

558
00:22:50,870 --> 00:22:48,400
calculation

559
00:22:52,310 --> 00:22:50,880
uh for some kind of reagent and you know

560
00:22:55,270 --> 00:22:52,320
forgetting to carry a zero and

561
00:22:57,990 --> 00:22:55,280
completely screwing up an experiment

562
00:22:59,990 --> 00:22:58,000
there also signs fails like

563
00:23:02,710 --> 00:23:00,000

one time we had a freezer that broke

564
00:23:05,029 --> 00:23:02,720
down on a long weekend so no one was

565
00:23:07,510 --> 00:23:05,039
around to hear the freezer alarms going

566
00:23:10,070 --> 00:23:07,520
off we lost very precious samples it was

567
00:23:11,510 --> 00:23:10,080
devastating at the time but but now it's

568
00:23:13,110 --> 00:23:11,520
you know it is laughable it wasn't a

569
00:23:15,510 --> 00:23:13,120
huge huge deal in the grand scheme of

570
00:23:21,110 --> 00:23:19,270
yeah definitely anything to add darlene

571
00:23:22,870 --> 00:23:21,120
well i think that's so well put and what

572
00:23:24,310 --> 00:23:22,880
you know just coming back to the job

573
00:23:26,950 --> 00:23:24,320
that we do we work in analog

574
00:23:28,230 --> 00:23:26,960
environments um and we're here on earth

575
00:23:30,310 --> 00:23:28,240
we're studying the earth but then of

576
00:23:32,070 --> 00:23:30,320
course unanticipating anticipation of

577
00:23:33,350 --> 00:23:32,080
studying other planetary systems but

578
00:23:35,270 --> 00:23:33,360
when we work here on earth we're

579
00:23:37,430 --> 00:23:35,280
actually also afforded the ability to

580
00:23:39,830 --> 00:23:37,440
kind of make mistakes mistakes that are

581
00:23:41,830 --> 00:23:39,840
far more more costly and impactful if

582
00:23:44,630 --> 00:23:41,840
you're making them in a singular flight

583
00:23:46,390 --> 00:23:44,640
mission you know to europa so

584
00:23:47,830 --> 00:23:46,400
mistakes are just part of the job and

585
00:23:50,470 --> 00:23:47,840
you have to live with it of course with

586
00:23:52,390 --> 00:23:50,480
that comes anxiety um and so you know

587
00:23:54,070 --> 00:23:52,400
again for all the younger listeners out

588
00:23:55,669 --> 00:23:54,080

there i think just knowing that you're

589
00:23:58,390 --> 00:23:55,679
going to make mistakes and you have to

590
00:23:59,750 --> 00:23:58,400
make mistakes in order to to to later on

591
00:24:01,510 --> 00:23:59,760
understand and you know how to move

592
00:24:02,950 --> 00:24:01,520
through things better that's just part

593
00:24:05,190 --> 00:24:02,960
of the program and anxiety just means

594
00:24:07,990 --> 00:24:05,200
that you care so um and you care

595
00:24:09,750 --> 00:24:08,000
intensely so it really is baked into the

596
00:24:11,830 --> 00:24:09,760
into the profession if you will to make

597
00:24:13,669 --> 00:24:11,840
mistakes and have a little anxiousness

598
00:24:14,950 --> 00:24:13,679
about the whole thing

599
00:24:17,269 --> 00:24:14,960
well said

600
00:24:22,630 --> 00:24:17,279
debbie on twitter wants to know what

601
00:24:29,190 --> 00:24:25,990
i work the most in canada here so canada

602
00:24:30,950 --> 00:24:29,200
has a lot of really cold environments

603
00:24:33,510 --> 00:24:30,960
we know a lot of our astrobiology

604
00:24:34,950 --> 00:24:33,520
targets are also cold environments so i

605
00:24:38,549 --> 00:24:34,960
work the most in the canadian high

606
00:24:43,430 --> 00:24:41,269
i think i've sort of worked all over the

607
00:24:45,350 --> 00:24:43,440
world to be honest

608
00:24:48,070 --> 00:24:45,360
and i used to work a lot in canada

609
00:24:51,269 --> 00:24:48,080
during my graduate program primarily in

610
00:24:53,350 --> 00:24:51,279
the canadian high arctic um but since

611
00:24:54,870 --> 00:24:53,360
then you know i sort of had the

612
00:24:57,510 --> 00:24:54,880
opportunity to work all over the place

613
00:25:00,870 --> 00:24:57,520

as well as underwater on water on desert

614
00:25:02,950 --> 00:25:00,880
you know on on land um and um there's

615
00:25:04,470 --> 00:25:02,960
just so many different opportunities you

616
00:25:06,070 --> 00:25:04,480
just have to figure out exactly what it

617
00:25:08,070 --> 00:25:06,080
is you're interested in what your

618
00:25:10,470 --> 00:25:08,080
specific question is and then go to the

619
00:25:12,870 --> 00:25:10,480
right place and make sure that place is

620
00:25:15,029 --> 00:25:12,880
safe that you can get to it um i mean

621
00:25:16,870 --> 00:25:15,039
you know without without um compromising

622
00:25:18,390 --> 00:25:16,880
anyone's safety and then you can make

623
00:25:20,630 --> 00:25:18,400
decisions from there so we're very

624
00:25:22,310 --> 00:25:20,640
selective and careful about where we go

625
00:25:24,149 --> 00:25:22,320
um but certainly there are lots of

626
00:25:26,390 --> 00:25:24,159
interesting places right in our own you

627
00:25:27,990 --> 00:25:26,400
know planetary backyard if you will to

628
00:25:29,830 --> 00:25:28,000
explore

629
00:25:32,310 --> 00:25:29,840
yeah absolutely

630
00:25:34,070 --> 00:25:32,320
okay uh pascal on periscope wants to

631
00:25:38,390 --> 00:25:34,080
know what is a regular day as an

632
00:25:46,310 --> 00:25:40,310
you pandemic or post

633
00:25:52,789 --> 00:25:50,070
uh well for me it typically looks like

634
00:25:55,029 --> 00:25:52,799
actually either being behind a computer

635
00:25:57,269 --> 00:25:55,039
or being in my lab so a lot of the work

636
00:26:00,470 --> 00:25:57,279
i do uh is

637
00:26:02,549 --> 00:26:00,480
extracting dna or genomic material uh

638
00:26:03,909 --> 00:26:02,559

from environments and so that takes

639
00:26:05,669 --> 00:26:03,919
place in the lab there's a lot of

640
00:26:08,149 --> 00:26:05,679
experimentation that goes with that in

641
00:26:10,390 --> 00:26:08,159
the lab but once i get my data back a

642
00:26:12,230 --> 00:26:10,400
lot of that is just crunching those

643
00:26:14,310 --> 00:26:12,240
numbers and looking at those dna

644
00:26:16,870 --> 00:26:14,320
sequences on my computer that's where i

645
00:26:18,870 --> 00:26:16,880
spend the vast majority of my time

646
00:26:20,870 --> 00:26:18,880
yep

647
00:26:22,710 --> 00:26:20,880
yeah here

648
00:26:24,390 --> 00:26:22,720
we you know for when we go out into the

649
00:26:26,710 --> 00:26:24,400
field a lot of times that's the moment

650
00:26:28,630 --> 00:26:26,720
in time that gets um aired you know

651
00:26:29,909 --> 00:26:28,640
through the press or just generally

652
00:26:31,669 --> 00:26:29,919
people tweet about when we're in the

653
00:26:33,430 --> 00:26:31,679
field so it seems to be the part that

654
00:26:36,149 --> 00:26:33,440
gets garners the most attention but in

655
00:26:37,669 --> 00:26:36,159
fact about you know 92 percent of our

656
00:26:39,350 --> 00:26:37,679
time is out of the field it's getting

657
00:26:40,870 --> 00:26:39,360
ready to go into the field so it's a lot

658
00:26:42,630 --> 00:26:40,880
of what jackie said you're in front of

659
00:26:44,230 --> 00:26:42,640
your computer uh whether it's you know

660
00:26:46,390 --> 00:26:44,240
you're with your data or you're working

661
00:26:48,630 --> 00:26:46,400
with people we're on we're in meetings

662
00:26:50,789 --> 00:26:48,640
um now you know video conferences all

663
00:26:53,110 --> 00:26:50,799

the time so it's a lot of personal

664
00:26:55,029 --> 00:26:53,120
interactions trying to build um

665
00:26:56,549 --> 00:26:55,039
processes so that we can tackle these

666
00:26:58,230 --> 00:26:56,559
really tough questions and then when you

667
00:27:00,070 --> 00:26:58,240
get into the field that is certainly

668
00:27:01,990 --> 00:27:00,080
where all that hard work kind of has to

669
00:27:03,590 --> 00:27:02,000
play out it's you know very much like

670
00:27:05,830 --> 00:27:03,600
getting ready and training to get into

671
00:27:08,549 --> 00:27:05,840
that intense moment in time where you

672
00:27:10,470 --> 00:27:08,559
really do have one shot to get it right

673
00:27:12,149 --> 00:27:10,480
yeah absolutely so we have about 30

674
00:27:13,990 --> 00:27:12,159
seconds left but a lot of people are

675
00:27:15,990 --> 00:27:14,000
asking and wondering what do they do in

676
00:27:17,909 --> 00:27:16,000
order to become an astrobiologist so

677
00:27:20,950 --> 00:27:17,919
really quickly jackie or darlene do you

678
00:27:22,710 --> 00:27:20,960
want to give them some advice

679
00:27:25,110 --> 00:27:22,720
follow your follow your dreams there's

680
00:27:26,789 --> 00:27:25,120
so many ways to become an astrobiologist

681
00:27:28,470 --> 00:27:26,799
and it's such an interdisciplinary

682
00:27:31,830 --> 00:27:28,480
science so if you're interested in

683
00:27:33,669 --> 00:27:31,840
chemistry even anthropology or biology

684
00:27:36,230 --> 00:27:33,679
you know follow that passion in whatever

685
00:27:38,070 --> 00:27:36,240
path works for you

686
00:27:40,870 --> 00:27:38,080
yeah i mean jackie says it really well

687
00:27:42,149 --> 00:27:40,880
so many different entry points

688
00:27:44,070 --> 00:27:42,159

it's exciting i'm sure there are going

689
00:27:46,310 --> 00:27:44,080
to be a lot of astrobiologists to come

690
00:27:47,909 --> 00:27:46,320
who are inspired by both of you

691
00:27:49,830 --> 00:27:47,919
unfortunately that is all the time we

692
00:27:52,549 --> 00:27:49,840
have today thank you so much jackie and

693
00:27:54,470 --> 00:27:52,559
darlene for joining us

694
00:27:56,149 --> 00:27:54,480
thank you thank you

695
00:27:57,750 --> 00:27:56,159
and thank you to everyone joining us at

696
00:27:59,350 --> 00:27:57,760
home if you'd like to learn more about

697
00:28:00,830 --> 00:27:59,360
nasa's search for life beyond earth

698
00:28:02,710 --> 00:28:00,840
visit

699
00:28:04,470 --> 00:28:02,720
astrobiology.nasa.gov can also follow

700
00:28:06,389 --> 00:28:04,480
along on social media on the nasa

701
00:28:08,149 --> 00:28:06,399
astrobiology accounts on facebook and

702
00:28:09,830 --> 00:28:08,159
twitter to learn more as nasa

703
00:28:11,430 --> 00:28:09,840
researchers venture to extreme and

704
00:28:13,750 --> 00:28:11,440
interesting locations on earth for their

705
00:28:15,269 --> 00:28:13,760
work follow nasa expeditions on facebook

706
00:28:17,029 --> 00:28:15,279
and twitter we are thrilled that you

707
00:28:18,789 --> 00:28:17,039
could join us as we talked with some

708
00:28:20,710 --> 00:28:18,799
trailblazing women dedicating their

709
00:28:22,549 --> 00:28:20,720
careers to finding life beyond earth

710
00:28:42,480 --> 00:28:22,559
happy women's history month and thank

711
00:28:42,490 --> 00:28:58,510
[Music]

712
00:28:58,520 --> 00:29:25,590
[Applause]

713
00:29:30,710 --> 00:29:28,870

well in my left hand i have a feather

714
00:29:32,950 --> 00:29:30,720
in my right hand a hammer

715
00:29:34,549 --> 00:29:32,960
and i guess one of the reasons uh we got

716
00:29:37,110 --> 00:29:34,559
here today was because of a gentleman

717
00:29:39,110 --> 00:29:37,120
named galileo a long time ago who made a

718
00:29:41,669 --> 00:29:39,120
rather significant discovery

719
00:29:43,269 --> 00:29:41,679
about falling objects in gravity fields

720
00:29:44,950 --> 00:29:43,279
and we thought that

721
00:29:47,669 --> 00:29:44,960
where would be a better place

722
00:29:49,510 --> 00:29:47,679
to confirm his uh findings and

723
00:29:51,430 --> 00:29:49,520
on the moon

724
00:29:52,389 --> 00:29:51,440
and so we thought we'd try it here for

725
00:29:54,149 --> 00:29:52,399
you

726
00:30:07,590 --> 00:29:54,159
the feather happens to be appropriately

727
00:30:12,310 --> 00:30:10,070
the blue marble

728
00:30:13,190 --> 00:30:12,320
that was our first

729
00:30:14,789 --> 00:30:13,200
view

730
00:30:16,950 --> 00:30:14,799
of ourselves

731
00:30:18,230 --> 00:30:16,960
we really are the blue planet we're

732
00:30:24,070 --> 00:30:18,240
hanging out here in the middle of

733
00:30:30,470 --> 00:30:27,750
in fact apollo imagery was part of the

734
00:30:31,669 --> 00:30:30,480
justification for putting together a

735
00:30:34,149 --> 00:30:31,679
satellite

736
00:30:36,870 --> 00:30:34,159
that would look at the earth

737
00:30:39,269 --> 00:30:36,880
that satellite was the first landsat

738
00:30:41,190 --> 00:30:39,279

the landsat mission now holds the title

739
00:30:46,310 --> 00:30:41,200
for the longest continuous space-based

740
00:30:51,269 --> 00:30:48,310
at least one landsat satellite has been

741
00:30:53,590 --> 00:30:51,279
orbiting the earth since 1972

742
00:30:54,950 --> 00:30:53,600
that's nearly 50 years of steadfast

743
00:30:56,549 --> 00:30:54,960
observation

744
00:30:58,630 --> 00:30:56,559
the program was born in the midst of

745
00:31:02,389 --> 00:30:58,640
several historical flash points during a

746
00:31:04,470 --> 00:31:02,399
time when the world was changing quickly