
No Alcohol

1
00:03:41,350 --> 00:03:39,350
on lab

2
00:03:43,430 --> 00:03:41,360
like christina we'll get a closer look

3
00:03:43,750 --> 00:03:43,440
behind the scenes at the facility she's

4
00:03:47,350 --> 00:03:43,760
in

5
00:03:52,229 --> 00:03:47,360
jessica

6
00:03:56,309 --> 00:03:52,239
let's start with that let's unpack that

7
00:03:59,030 --> 00:03:56,319
a little bit what is fault protection

8
00:04:00,149 --> 00:03:59,040
yeah thank you stephanie um so fault

9
00:04:03,509 --> 00:04:00,159
protection

10
00:04:06,229 --> 00:04:03,519
is uh kind of a unique field at jpl

11
00:04:07,509 --> 00:04:06,239
and the metaphor uh that i sometimes

12
00:04:10,149 --> 00:04:07,519
hear people use is that

13
00:04:11,190 --> 00:04:10,159

we're kind of like the doctors for the

14
00:04:14,309 --> 00:04:11,200
rover so

15
00:04:17,349 --> 00:04:14,319
um we because there there's nobody

16
00:04:18,949 --> 00:04:17,359
to take care of the rover on mars or

17
00:04:21,349 --> 00:04:18,959
in route to mars if it encounters an

18
00:04:23,990 --> 00:04:21,359
issue we actually have to

19
00:04:25,110 --> 00:04:24,000
equip perseverance with the ability to

20
00:04:28,950 --> 00:04:25,120
diagnose

21
00:04:30,230 --> 00:04:28,960
um problems on itself so we build in all

22
00:04:33,430 --> 00:04:30,240
of the software

23
00:04:34,629 --> 00:04:33,440
to help perseverance detect if something

24
00:04:37,590 --> 00:04:34,639
has gone wrong

25
00:04:39,030 --> 00:04:37,600
and then there actually are several

26
00:04:42,310 --> 00:04:39,040
spare

27
00:04:45,270 --> 00:04:42,320
components that she can use

28
00:04:45,830 --> 00:04:45,280
and swap to if she encounters an issue

29
00:04:48,950 --> 00:04:45,840
so

30
00:04:51,110 --> 00:04:48,960
um in addition to that we uh

31
00:04:52,230 --> 00:04:51,120
we kind of operate like the doctors in

32
00:04:55,749 --> 00:04:52,240
operations

33
00:04:58,150 --> 00:04:55,759
once she's on her way to mars because we

34
00:05:00,230 --> 00:04:58,160
if there is a problem perseverance

35
00:05:01,110 --> 00:05:00,240
notifies the team on the ground and then

36
00:05:03,670 --> 00:05:01,120
we work

37
00:05:04,629 --> 00:05:03,680
to try to diagnose what's going on and

38
00:05:08,390 --> 00:05:04,639

try to get her

39
00:05:09,430 --> 00:05:08,400
back to full operations now you're at

40
00:05:13,029 --> 00:05:09,440
home right now

41
00:05:16,870 --> 00:05:13,039
you'll be on console at jpl tomorrow

42
00:05:17,510 --> 00:05:16,880
what will you be doing um hopefully not

43
00:05:20,469 --> 00:05:17,520
getting too

44
00:05:21,189 --> 00:05:20,479
nervous but uh really just getting

45
00:05:24,230 --> 00:05:21,199
excited

46
00:05:26,390 --> 00:05:24,240
and we're going our team is going to

47
00:05:27,670 --> 00:05:26,400
be looking at the data coming from

48
00:05:29,270 --> 00:05:27,680
perseverance

49
00:05:30,870 --> 00:05:29,280
and assessing whether everything looks

50
00:05:33,909 --> 00:05:30,880
nominal um

51
00:05:35,029 --> 00:05:33,919
both before the launch and then after we

52
00:05:38,550 --> 00:05:35,039
launch

53
00:05:40,629 --> 00:05:38,560
about 45

54
00:05:42,150 --> 00:05:40,639
minutes or so before we we go into

55
00:05:44,710 --> 00:05:42,160
what's called an eclipse

56
00:05:45,189 --> 00:05:44,720
so we'll go behind the earth and the sun

57
00:05:47,749 --> 00:05:45,199
will

58
00:05:49,110 --> 00:05:47,759
be blocked out and during that time we

59
00:05:52,710 --> 00:05:49,120
will separate from

60
00:05:55,029 --> 00:05:52,720
the the rocket and so that period of

61
00:05:58,469 --> 00:05:55,039
time we'll actually lose data

62
00:05:59,990 --> 00:05:58,479
lose visibility and then we when we come

63
00:06:02,950 --> 00:06:00,000

out of that eclipse we will

64
00:06:04,790 --> 00:06:02,960
begin receiving data from perseverance's

65
00:06:06,710 --> 00:06:04,800
own radio so

66
00:06:08,950 --> 00:06:06,720
that'll be a huge event where we're

67
00:06:10,230 --> 00:06:08,960
looking forward to seeing

68
00:06:12,309 --> 00:06:10,240
data for the first time being

69
00:06:15,430 --> 00:06:12,319
transmitted by perseverance on

70
00:06:17,350 --> 00:06:15,440
on its own radio

71
00:06:19,590 --> 00:06:17,360
i can't wait to see what the what the

72
00:06:21,430 --> 00:06:19,600
shot looks like out of mission control

73
00:06:23,510 --> 00:06:21,440
although you'll all be social distancing

74
00:06:24,870 --> 00:06:23,520
so maybe not quite as many high fives

75
00:06:27,110 --> 00:06:24,880
right

76
00:06:28,150 --> 00:06:27,120
correct yeah we actually had to do a lot

77
00:06:29,670 --> 00:06:28,160
to um

78
00:06:31,510 --> 00:06:29,680
kind of work in this new realm with

79
00:06:34,070 --> 00:06:31,520
covid so we have very

80
00:06:35,029 --> 00:06:34,080
strict cleaning guidelines when we come

81
00:06:36,390 --> 00:06:35,039
into our console

82
00:06:38,950 --> 00:06:36,400
we're all going to be wearing masks so

83
00:06:42,309 --> 00:06:38,960
you won't really be able to see us

84
00:06:42,790 --> 00:06:42,319
smiling ear to ear and then you know our

85
00:06:45,110 --> 00:06:42,800
typical

86
00:06:47,510 --> 00:06:45,120
jumping up and down and high fives you

87
00:06:50,150 --> 00:06:47,520
probably won't see us doing that

88
00:06:50,950 --> 00:06:50,160

and we are going to try to eat peanuts

89
00:06:53,270 --> 00:06:50,960
which is

90
00:06:54,070 --> 00:06:53,280
a good luck tradition but we will be

91
00:06:57,350 --> 00:06:54,080
doing it

92
00:06:58,790 --> 00:06:57,360
in a very discreet and safer way um

93
00:07:01,270 --> 00:06:58,800
but still want to try to carry that

94
00:07:03,830 --> 00:07:01,280
tradition through

95
00:07:04,870 --> 00:07:03,840
fantastic all right so i've got a

96
00:07:06,870 --> 00:07:04,880
million questions

97
00:07:08,150 --> 00:07:06,880
but that pales in comparison to the

98
00:07:09,430 --> 00:07:08,160
number of questions who are coming in

99
00:07:10,790 --> 00:07:09,440
from people online

100
00:07:12,790 --> 00:07:10,800
and i want to make sure we get as many

101
00:07:15,670 --> 00:07:12,800
as possible so um

102
00:07:17,670 --> 00:07:15,680
over on twitter fragile fern has a

103
00:07:19,430 --> 00:07:17,680
software question for you

104
00:07:20,710 --> 00:07:19,440
so speaking as a software developer

105
00:07:22,390 --> 00:07:20,720
she's curious what

106
00:07:24,790 --> 00:07:22,400
programming language do you use to

107
00:07:28,469 --> 00:07:24,800
control various functions

108
00:07:29,110 --> 00:07:28,479
um on the rover that is a really good

109
00:07:31,749 --> 00:07:29,120
question

110
00:07:32,790 --> 00:07:31,759
um so i actually don't write the

111
00:07:35,110 --> 00:07:32,800
software but we

112
00:07:36,309 --> 00:07:35,120
um we do what we call specify it for our

113
00:07:38,790 --> 00:07:36,319

software engineers

114
00:07:39,670 --> 00:07:38,800
to go and write the code and it's all in

115
00:07:42,629 --> 00:07:39,680
c

116
00:07:43,670 --> 00:07:42,639
so um you might be familiar with that

117
00:07:47,029 --> 00:07:43,680
and um

118
00:07:51,189 --> 00:07:47,039
yeah it's uh there's no special jpl

119
00:07:54,469 --> 00:07:52,629
excellent excellent now i'm just

120
00:07:57,350 --> 00:07:54,479
scanning through here

121
00:08:00,550 --> 00:07:57,360
let's see um cameras may i ask you a

122
00:08:04,869 --> 00:08:00,560
question about the cameras

123
00:08:06,629 --> 00:08:04,879
sure all right so um

124
00:08:08,469 --> 00:08:06,639
here we go a mall on twitter wants to

125
00:08:09,110 --> 00:08:08,479
know how will perseverance clean its

126
00:08:13,189 --> 00:08:09,120
cameras

127
00:08:16,070 --> 00:08:13,199
um what if dust particles cover it

128
00:08:17,749 --> 00:08:16,080
that's a really good question so i'm not

129
00:08:18,469 --> 00:08:17,759
quite as familiar with the cameras but i

130
00:08:20,550 --> 00:08:18,479
do know we

131
00:08:21,909 --> 00:08:20,560
when we land we're worried about dust

132
00:08:25,110 --> 00:08:21,919
accumulation

133
00:08:26,710 --> 00:08:25,120
from landing itself so

134
00:08:28,469 --> 00:08:26,720
the cameras are equipped with dust

135
00:08:30,309 --> 00:08:28,479
covers that then

136
00:08:32,070 --> 00:08:30,319
once all that dust has settled and we've

137
00:08:32,790 --> 00:08:32,080
been on the surface safely we pop them

138
00:08:35,990 --> 00:08:32,800

off

139
00:08:38,469 --> 00:08:36,000
um if after that fact

140
00:08:39,990 --> 00:08:38,479
there is some dust accumulation i don't

141
00:08:42,550 --> 00:08:40,000
think there's that much we can do other

142
00:08:43,190 --> 00:08:42,560
than kind of rely on the ambient winds

143
00:08:46,630 --> 00:08:43,200
to

144
00:08:48,310 --> 00:08:46,640
clean them off um but i know on msl

145
00:08:50,310 --> 00:08:48,320
uh you know which has been on the

146
00:08:51,030 --> 00:08:50,320
surface of mars for years now we haven't

147
00:08:54,070 --> 00:08:51,040
had any

148
00:08:56,070 --> 00:08:54,080
major issues with dust accumulations so

149
00:08:58,870 --> 00:08:56,080
i think we're kind of hoping for the

150
00:09:01,990 --> 00:09:01,350
all right and um you know a lot of folks

151
00:09:03,990 --> 00:09:02,000
want to know

152
00:09:06,710 --> 00:09:04,000
you know how do you even get a job like

153
00:09:10,070 --> 00:09:06,720
this uh what was the path that you took

154
00:09:12,550 --> 00:09:10,080
to get to jpl yeah

155
00:09:13,670 --> 00:09:12,560
it's kind of a winding and seemingly

156
00:09:15,990 --> 00:09:13,680
random path

157
00:09:17,350 --> 00:09:16,000
uh there's a you can't major in fault

158
00:09:21,829 --> 00:09:17,360
protection engineering

159
00:09:23,350 --> 00:09:21,839
um in college so um i uh

160
00:09:25,829 --> 00:09:23,360
you know realized i wanted to be an

161
00:09:29,030 --> 00:09:25,839
engineer around when i was a senior

162
00:09:32,790 --> 00:09:29,040
in high school um and i applied to

163
00:09:35,190 --> 00:09:32,800

georgia tech i switched majors two times

164
00:09:37,110 --> 00:09:35,200
i went from undecided to biomedical i

165
00:09:40,150 --> 00:09:37,120
thought i wanted to be a real doctor

166
00:09:43,350 --> 00:09:40,160
then realize that wasn't for me um so

167
00:09:45,269 --> 00:09:43,360
i went into aerospace engineering

168
00:09:46,389 --> 00:09:45,279
and just happened to kind of fall in

169
00:09:49,509 --> 00:09:46,399
love with it

170
00:09:50,790 --> 00:09:49,519
and through that i got internships at

171
00:09:53,829 --> 00:09:50,800
jpl

172
00:09:55,829 --> 00:09:53,839
and that was a great way to um kind of

173
00:09:59,509 --> 00:09:55,839
get it

174
00:10:03,190 --> 00:09:59,519
acquainted with jpl and how nasa works

175
00:10:04,949 --> 00:10:03,200
so um through that i got hired at jpl

176
00:10:07,350 --> 00:10:04,959
and then fault protection again was

177
00:10:10,949 --> 00:10:07,360
something i had never

178
00:10:12,949 --> 00:10:10,959
had prior experience in but i um

179
00:10:14,470 --> 00:10:12,959
i actually completely love doing fall

180
00:10:16,230 --> 00:10:14,480
protection engineering and i

181
00:10:19,110 --> 00:10:16,240
and i don't know if i'll ever kind of

182
00:10:21,910 --> 00:10:19,120
switch out of it

183
00:10:22,710 --> 00:10:21,920
fantastic okay so i want to make sure

184
00:10:25,190 --> 00:10:22,720
that we get

185
00:10:25,829 --> 00:10:25,200
um to all of our panelists here so

186
00:10:27,350 --> 00:10:25,839
jessica

187
00:10:30,550 --> 00:10:27,360
hang on we're going to switch things

188
00:10:33,829 --> 00:10:30,560

over to the jet propulsion laboratory

189
00:10:36,230 --> 00:10:33,839
where christina hernandez is in a very

190
00:10:38,310 --> 00:10:36,240
very special place one of our indoor

191
00:10:40,310 --> 00:10:38,320
mars yards christina tell us more

192
00:10:42,069 --> 00:10:40,320
about the lab you're in and what's going

193
00:10:44,630 --> 00:10:42,079
on there

194
00:10:46,389 --> 00:10:44,640
yeah uh so thanks for having me um so

195
00:10:47,190 --> 00:10:46,399
right now i'm in the flight software

196
00:10:50,230 --> 00:10:47,200
test bed

197
00:10:52,710 --> 00:10:50,240
um so it's basically an indoor mars yard

198
00:10:55,190 --> 00:10:52,720
and um we do have kobit protocol but i

199
00:10:55,750 --> 00:10:55,200
took my mask off my mars 2020 issued

200
00:10:58,150 --> 00:10:55,760
mask

201
00:11:00,150 --> 00:10:58,160
uh since nobody else is around right now

202
00:11:02,790 --> 00:11:00,160
but basically behind me what you have

203
00:11:03,750 --> 00:11:02,800
is the start of the twin that will

204
00:11:06,310 --> 00:11:03,760
eventually become

205
00:11:08,230 --> 00:11:06,320
mars perseverance's twin and what we do

206
00:11:10,150 --> 00:11:08,240
in here is we test the higher level

207
00:11:13,190 --> 00:11:10,160
behaviors of this robotic

208
00:11:15,030 --> 00:11:13,200
geologist and astrobiologists so behind

209
00:11:16,630 --> 00:11:15,040
me we've got the robotic arm in the

210
00:11:19,190 --> 00:11:16,640
stowed configuration

211
00:11:20,150 --> 00:11:19,200
at the very top um we have the turret

212
00:11:22,069 --> 00:11:20,160
and on the turret

213
00:11:23,190 --> 00:11:22,079

um we'll have sherlock we have sherlock

214
00:11:25,829 --> 00:11:23,200
on the other side

215
00:11:27,269 --> 00:11:25,839
and on tuesday the pixel em sensor

216
00:11:29,030 --> 00:11:27,279
assembly one of our other science

217
00:11:31,269 --> 00:11:29,040
instruments will be getting installed

218
00:11:33,190 --> 00:11:31,279
for some robotic arm testing and so we

219
00:11:35,110 --> 00:11:33,200
test you know all kinds of things we

220
00:11:37,990 --> 00:11:35,120
take images with the instruments

221
00:11:39,750 --> 00:11:38,000
we look at rocks we drill rocks and we

222
00:11:41,670 --> 00:11:39,760
try and test the end-to-end

223
00:11:43,350 --> 00:11:41,680
behavior that we're going to see once we

224
00:11:45,509 --> 00:11:43,360
get to mars

225
00:11:47,110 --> 00:11:45,519
fantastic now i know that you are an

226
00:11:50,150 --> 00:11:47,120
instrument engineer

227
00:11:53,269 --> 00:11:50,160
currently working on pixel what does an

228
00:11:57,110 --> 00:11:55,509
it's a fun job sometimes it's a little

229
00:11:57,590 --> 00:11:57,120
chaotic but i think that's why we all

230
00:12:00,389 --> 00:11:57,600
became

231
00:12:01,509 --> 00:12:00,399
engineers to solve tough problems so

232
00:12:04,550 --> 00:12:01,519
instrument engineers

233
00:12:06,470 --> 00:12:04,560
their job is to understand the rover and

234
00:12:08,629 --> 00:12:06,480
how it interacts with the instruments

235
00:12:11,110 --> 00:12:08,639
but at the same time understand all the

236
00:12:12,150 --> 00:12:11,120
nuts and bolts in behaviors and quirks

237
00:12:13,910 --> 00:12:12,160
as we call them

238
00:12:15,670 --> 00:12:13,920

of the seven different science

239
00:12:17,190 --> 00:12:15,680
instruments so we have a team of

240
00:12:19,190 --> 00:12:17,200
instrument engineers

241
00:12:21,030 --> 00:12:19,200
who have been apart from the early

242
00:12:22,629 --> 00:12:21,040
design and accommodation of the

243
00:12:24,710 --> 00:12:22,639
instruments on the rover

244
00:12:26,310 --> 00:12:24,720
through uh assembly tests and launch

245
00:12:27,350 --> 00:12:26,320
operations where we were testing with

246
00:12:29,190 --> 00:12:27,360
the flight vehicle

247
00:12:31,509 --> 00:12:29,200
and with engineers like jessica on

248
00:12:33,430 --> 00:12:31,519
console and then now we're getting ready

249
00:12:35,590 --> 00:12:33,440
to prepare for our operations and

250
00:12:37,110 --> 00:12:35,600
understanding what are the tools

251
00:12:39,509 --> 00:12:37,120
that scientists like joby that you'll

252
00:12:42,069 --> 00:12:39,519
hear from uh later are gonna need to do

253
00:12:45,110 --> 00:12:42,079
cool science on mars

254
00:12:47,990 --> 00:12:45,120
okay so question from our youtube chat

255
00:12:50,870 --> 00:12:48,000
uh laxmi pandit wants to know how was

256
00:12:55,190 --> 00:12:50,880
the rover built

257
00:12:58,870 --> 00:12:57,350
it's just an exciting question because

258
00:13:01,269 --> 00:12:58,880
this is not the effort of

259
00:13:02,949 --> 00:13:01,279
a few engineers it's the effort um of

260
00:13:04,550 --> 00:13:02,959
not just the united states also but our

261
00:13:07,110 --> 00:13:04,560
global collaborators in

262
00:13:07,670 --> 00:13:07,120
france norway and spain and many other

263
00:13:09,910 --> 00:13:07,680

places

264
00:13:10,790 --> 00:13:09,920
so basically we had different groups of

265
00:13:12,870 --> 00:13:10,800
teams build

266
00:13:14,230 --> 00:13:12,880
the boxes the instruments the different

267
00:13:17,190 --> 00:13:14,240
subsystems

268
00:13:17,829 --> 00:13:17,200
most of it was built here at jpl and at

269
00:13:19,829 --> 00:13:17,839
jpl

270
00:13:21,910 --> 00:13:19,839
is where we integrated and assembled it

271
00:13:22,949 --> 00:13:21,920
all together and so it started from a

272
00:13:24,870 --> 00:13:22,959
paper design

273
00:13:26,069 --> 00:13:24,880
about 10 years ago and now it's

274
00:13:27,829 --> 00:13:26,079
manifested to a one

275
00:13:29,829 --> 00:13:27,839
ton beast of a thing that's on a launch

276
00:13:32,790 --> 00:13:29,839
pad today

277
00:13:33,269 --> 00:13:32,800
fantastic oh my goodness we're getting

278
00:13:35,670 --> 00:13:33,279
so

279
00:13:37,190 --> 00:13:35,680
many questions here from all over the

280
00:13:40,470 --> 00:13:37,200
world

281
00:13:41,670 --> 00:13:40,480
ah fantastic all right i'm seeing

282
00:13:43,189 --> 00:13:41,680
several here where

283
00:13:45,350 --> 00:13:43,199
multiple of you are going to be able to

284
00:13:47,269 --> 00:13:45,360
weigh in and so i'm going to wait and

285
00:13:49,110 --> 00:13:47,279
hold those for a few minutes in the show

286
00:13:51,110 --> 00:13:49,120
here and switch things over

287
00:13:53,350 --> 00:13:51,120
to uh joby thank you christina we'll be

288
00:13:55,629 --> 00:13:53,360

back with you in just a moment

289
00:13:56,790 --> 00:13:55,639
now joby joby brazil hollis

290
00:13:58,949 --> 00:13:56,800
astrobiologist

291
00:14:00,949 --> 00:13:58,959
postdoctoral scholar working on the

292
00:14:03,269 --> 00:14:00,959
sherlock instrument

293
00:14:03,990 --> 00:14:03,279
let's uh let's talk about what all of

294
00:14:08,550 --> 00:14:04,000
that means

295
00:14:15,110 --> 00:14:11,910
so astrobiology is basically

296
00:14:16,069 --> 00:14:15,120
the study mostly theoretical at the

297
00:14:19,350 --> 00:14:16,079
moment

298
00:14:22,870 --> 00:14:19,360
of what life could be beyond earth

299
00:14:25,509 --> 00:14:22,880
so the question of like if life existed

300
00:14:26,230 --> 00:14:25,519
on a world like mars what did it look

301
00:14:28,230 --> 00:14:26,240
like

302
00:14:30,470 --> 00:14:28,240
uh you know was it made from the same

303
00:14:32,230 --> 00:14:30,480
molecules of like dna

304
00:14:33,910 --> 00:14:32,240
that we are or was it made from

305
00:14:35,670 --> 00:14:33,920
something completely different

306
00:14:37,750 --> 00:14:35,680
uh so a lot of this is kind of like

307
00:14:40,150 --> 00:14:37,760
investigating the kinds of

308
00:14:41,030 --> 00:14:40,160
molecules that might be available on

309
00:14:42,470 --> 00:14:41,040
other worlds

310
00:14:43,990 --> 00:14:42,480
and trying to work out how would they

311
00:14:45,189 --> 00:14:44,000
fit together you know what would you

312
00:14:48,230 --> 00:14:45,199
expect to see

313
00:14:50,389 --> 00:14:48,240

billions of years later um how would

314
00:14:52,470 --> 00:14:50,399
life survive in such an extremely

315
00:14:52,870 --> 00:14:52,480
different environment like that of mars

316
00:14:59,590 --> 00:14:52,880
or

317
00:15:01,269 --> 00:14:59,600
now obviously we have only discovered

318
00:15:04,069 --> 00:15:01,279
life on one planet so far

319
00:15:05,269 --> 00:15:04,079
earth uh so a lot of this is quite like

320
00:15:06,629 --> 00:15:05,279
investigative like

321
00:15:08,069 --> 00:15:06,639
we we're still not sure what we're

322
00:15:12,470 --> 00:15:08,079
looking for but we're pretty certain

323
00:15:15,670 --> 00:15:12,480
that when we find it we'll know

324
00:15:17,350 --> 00:15:15,680
so eduardo over on facebook has a

325
00:15:17,750 --> 00:15:17,360
question for you you mentioned looking

326
00:15:19,990 --> 00:15:17,760
for

327
00:15:21,670 --> 00:15:20,000
molecules and possibly new molecules

328
00:15:23,509 --> 00:15:21,680
there on mars

329
00:15:26,470 --> 00:15:23,519
he wants to know is it possible to find

330
00:15:28,870 --> 00:15:26,480
a new chemical element on mars or

331
00:15:31,189 --> 00:15:28,880
another compound that might not exist on

332
00:15:33,829 --> 00:15:31,199
earth

333
00:15:35,910 --> 00:15:33,839
uh so in terms of elements those are

334
00:15:38,150 --> 00:15:35,920
pretty well established you know we've

335
00:15:40,230 --> 00:15:38,160
discovered all pretty much all of the

336
00:15:43,189 --> 00:15:40,240
sort of naturally occurring elements

337
00:15:44,790 --> 00:15:43,199
that form through stellar fusion or

338
00:15:46,949 --> 00:15:44,800

supernovae that sort of thing

339
00:15:48,069 --> 00:15:46,959
so that's kind of everything up to iron

340
00:15:49,990 --> 00:15:48,079
and beyond

341
00:15:51,189 --> 00:15:50,000
uh the super heavy elements that are

342
00:15:52,829 --> 00:15:51,199
still being discovered

343
00:15:54,550 --> 00:15:52,839
these days are being made in particle

344
00:15:56,069 --> 00:15:54,560
accelerators so they're not really

345
00:15:57,509 --> 00:15:56,079
something we would expect to find like

346
00:15:59,509 --> 00:15:57,519
naturally occurring

347
00:16:01,350 --> 00:15:59,519
on the surface of a planet like mars

348
00:16:04,389 --> 00:16:01,360
when it comes to chemicals and

349
00:16:04,870 --> 00:16:04,399
molecules there's a huge number like

350
00:16:07,269 --> 00:16:04,880
almost

351
00:16:10,069 --> 00:16:07,279
infinite number of possible combinations

352
00:16:12,069 --> 00:16:10,079
atoms that can make molecules

353
00:16:13,430 --> 00:16:12,079
now some of them are unstable and we

354
00:16:15,670 --> 00:16:13,440
would not expect to find them

355
00:16:17,509 --> 00:16:15,680
the ones that make up us you know so we

356
00:16:20,470 --> 00:16:17,519
we comprise a dna that's com

357
00:16:21,670 --> 00:16:20,480
that has four distinct nucleobases in it

358
00:16:23,749 --> 00:16:21,680
so those are a c

359
00:16:25,350 --> 00:16:23,759
g and t that you might remember from

360
00:16:27,030 --> 00:16:25,360
biology classes at school

361
00:16:29,110 --> 00:16:27,040
now it's quite possible that alien life

362
00:16:31,030 --> 00:16:29,120
might have something similar to dna

363
00:16:33,110 --> 00:16:31,040

that just uses slightly different set of

364
00:16:35,030 --> 00:16:33,120
molecules so you know you add a methyl

365
00:16:36,230 --> 00:16:35,040
group there you put a nitrogen somewhere

366
00:16:37,110 --> 00:16:36,240
else and suddenly it's a slightly

367
00:16:38,629 --> 00:16:37,120
different molecule

368
00:16:40,470 --> 00:16:38,639
which means it may not be compatible

369
00:16:41,030 --> 00:16:40,480
with us but it could still be a valid

370
00:16:43,350 --> 00:16:41,040
way

371
00:16:44,470 --> 00:16:43,360
of building like an information storage

372
00:16:46,710 --> 00:16:44,480
system like dna

373
00:16:47,749 --> 00:16:46,720
something that could be passed on and

374
00:16:50,389 --> 00:16:47,759
from one

375
00:16:51,590 --> 00:16:50,399
organism to the next so we don't really

376
00:16:53,509 --> 00:16:51,600
know what to expect

377
00:16:55,350 --> 00:16:53,519
we're sort of built working from our

378
00:16:55,829 --> 00:16:55,360
what we know on earth so we're looking

379
00:16:57,990 --> 00:16:55,839
for

380
00:16:59,350 --> 00:16:58,000
stuff like dna first we have certain

381
00:17:01,269 --> 00:16:59,360
ideas about like you know

382
00:17:02,629 --> 00:17:01,279
life needs to be somewhat complicated to

383
00:17:04,390 --> 00:17:02,639
be able to do clever things like

384
00:17:06,230 --> 00:17:04,400
metabolize and

385
00:17:07,590 --> 00:17:06,240
reproduce you know that involves a lot

386
00:17:10,630 --> 00:17:07,600
of like quite clever

387
00:17:12,150 --> 00:17:10,640
chemical machinery um that

388
00:17:13,990 --> 00:17:12,160

needs required and that so that requires

389
00:17:15,110 --> 00:17:14,000
a certain minimum amount of complexity

390
00:17:16,710 --> 00:17:15,120
so we're looking at lots of different

391
00:17:18,309 --> 00:17:16,720
molecules put together

392
00:17:20,630 --> 00:17:18,319
um in a way that we have not yet

393
00:17:20,949 --> 00:17:20,640
observed in any of the studies we've

394
00:17:23,270 --> 00:17:20,959
done

395
00:17:24,150 --> 00:17:23,280
of organic molecules from things like

396
00:17:26,710 --> 00:17:24,160
meteorites

397
00:17:28,230 --> 00:17:26,720
samples of mars have crashed on earth

398
00:17:30,070 --> 00:17:28,240
from hundreds of millions of years ago

399
00:17:30,390 --> 00:17:30,080
we found organic molecules but they're

400
00:17:32,549 --> 00:17:30,400
all

401
00:17:33,430 --> 00:17:32,559
extremely simple stuff that could have

402
00:17:35,750 --> 00:17:33,440
just formed

403
00:17:37,350 --> 00:17:35,760
through like natural geochemistry so

404
00:17:38,950 --> 00:17:37,360
like the chemistry of rocks

405
00:17:41,830 --> 00:17:38,960
so they could be the building blocks of

406
00:17:45,190 --> 00:17:41,840
life but they are not proof of life

407
00:17:46,710 --> 00:17:45,200
now on that note uh keisha over on

408
00:17:51,430 --> 00:17:46,720
facebook wants to know

409
00:17:54,950 --> 00:17:54,070
okay that is a very big question i do

410
00:17:56,789 --> 00:17:54,960
not feel

411
00:17:58,630 --> 00:17:56,799
like i am qualified to answer that i'm

412
00:18:02,870 --> 00:17:58,640
not sure if anyone really

413
00:18:05,990 --> 00:18:02,880

is qualified to answer that uh but

414
00:18:08,470 --> 00:18:06,000
certainly in terms of the life we see

415
00:18:09,830 --> 00:18:08,480
on earth uh the i mean there's some

416
00:18:10,870 --> 00:18:09,840
disagreement about whether it's stuff

417
00:18:13,350 --> 00:18:10,880
like a virus

418
00:18:14,230 --> 00:18:13,360
is a living thing because it it usually

419
00:18:15,990 --> 00:18:14,240
co-ops

420
00:18:17,750 --> 00:18:16,000
the chemical machinery of another

421
00:18:20,710 --> 00:18:17,760
organism to be able to reproduce

422
00:18:22,470 --> 00:18:20,720
but generally life as we know it

423
00:18:24,549 --> 00:18:22,480
consumes energy

424
00:18:27,190 --> 00:18:24,559
it creates complex structures that

425
00:18:29,750 --> 00:18:27,200
wouldn't occur spontaneously

426
00:18:31,510 --> 00:18:29,760
and basically reproduce so kind of makes

427
00:18:33,510 --> 00:18:31,520
copies of itself

428
00:18:35,270 --> 00:18:33,520
so right now the molecules we found on

429
00:18:37,270 --> 00:18:35,280
mars through previous investigations so

430
00:18:40,150 --> 00:18:37,280
for example the viking landers

431
00:18:42,310 --> 00:18:40,160
uh the curiosity rover they've found

432
00:18:43,909 --> 00:18:42,320
very very simple molecules but they are

433
00:18:45,190 --> 00:18:43,919
all stuff that can occur through just

434
00:18:47,669 --> 00:18:45,200
natural chemistry

435
00:18:48,470 --> 00:18:47,679
they are not proof of life because they

436
00:18:50,150 --> 00:18:48,480
are they

437
00:18:51,909 --> 00:18:50,160
they're just not complicated enough that

438
00:18:56,310 --> 00:18:51,919

we we cannot

439
00:18:58,470 --> 00:18:56,320
uh ignore any other possible explanation

440
00:18:59,510 --> 00:18:58,480
well okay now that you've tackled one of

441
00:19:01,669 --> 00:18:59,520
the the biggest

442
00:19:03,510 --> 00:19:01,679
questions out there uh thank you it's

443
00:19:04,150 --> 00:19:03,520
all just gonna be so much easier from

444
00:19:07,350 --> 00:19:04,160
here on

445
00:19:10,230 --> 00:19:07,360
out and uh and not one of us uh

446
00:19:12,230 --> 00:19:10,240
can do this mission by themselves so at

447
00:19:14,150 --> 00:19:12,240
this point let's bring everybody back

448
00:19:15,750 --> 00:19:14,160
and start to get some perspectives from

449
00:19:19,029 --> 00:19:15,760
everybody because the work

450
00:19:21,270 --> 00:19:19,039
that the free of you do as part of this

451
00:19:21,750 --> 00:19:21,280
mission team with thousands of people on

452
00:19:23,909 --> 00:19:21,760
it

453
00:19:26,070 --> 00:19:23,919
is all interconnected we've got

454
00:19:28,150 --> 00:19:26,080
scientists asking the big questions

455
00:19:30,470 --> 00:19:28,160
and we've got engineers figuring out how

456
00:19:31,270 --> 00:19:30,480
do we make and use the tools that we

457
00:19:33,669 --> 00:19:31,280
have

458
00:19:35,270 --> 00:19:33,679
to answer those questions so i'd like to

459
00:19:36,830 --> 00:19:35,280
start off this group

460
00:19:38,789 --> 00:19:36,840
discussion or group portion of the

461
00:19:42,310 --> 00:19:38,799
discussion uh with

462
00:19:44,230 --> 00:19:42,320
looking at how how is this rover how are

463
00:19:47,270 --> 00:19:44,240

the instruments on this rover

464
00:19:50,470 --> 00:19:47,280
going to help us specifically

465
00:19:54,630 --> 00:19:50,480
try to fulfill that mission goal of

466
00:19:58,549 --> 00:19:54,640
finding evidence of life agent life

467
00:19:59,990 --> 00:19:58,559
on mars do we want to start with the

468
00:20:01,510 --> 00:20:00,000
okay you can rochambeau do you want to

469
00:20:04,230 --> 00:20:01,520
start with the hardware or with the

470
00:20:09,990 --> 00:20:07,190
i was going to start with the hardware

471
00:20:11,669 --> 00:20:10,000
it seems simplest let's start there

472
00:20:14,630 --> 00:20:11,679
yeah then we'll get we'll have joby

473
00:20:16,789 --> 00:20:14,640
finish it up and polish it off

474
00:20:18,630 --> 00:20:16,799
so we have seven instruments on the

475
00:20:19,990 --> 00:20:18,640
rover and when they were selected they

476
00:20:21,510 --> 00:20:20,000
were selected with the intent

477
00:20:23,430 --> 00:20:21,520
that they should all complement each

478
00:20:25,350 --> 00:20:23,440
other to meet one of our

479
00:20:26,870 --> 00:20:25,360
that science objective of looking for

480
00:20:29,669 --> 00:20:26,880
signs of ancient life

481
00:20:31,190 --> 00:20:29,679
and so we have um three spectrometers on

482
00:20:33,990 --> 00:20:31,200
the rover uh supercam

483
00:20:34,710 --> 00:20:34,000
sherlock and pixel and they're going to

484
00:20:37,510 --> 00:20:34,720
be using

485
00:20:39,510 --> 00:20:37,520
um chemistry um and astrobiology

486
00:20:40,710 --> 00:20:39,520
processes to try and understand you know

487
00:20:42,789 --> 00:20:40,720
what chemicals

488
00:20:43,750 --> 00:20:42,799

and uh organics are present on the

489
00:20:45,990 --> 00:20:43,760
samples that will

490
00:20:47,029 --> 00:20:46,000
uh drill up with the rover at the same

491
00:20:48,710 --> 00:20:47,039
time though we need

492
00:20:50,870 --> 00:20:48,720
context and that's one thing that i

493
00:20:52,789 --> 00:20:50,880
appreciated being an engineer is

494
00:20:55,270 --> 00:20:52,799
if you have a piece of data you need the

495
00:20:57,270 --> 00:20:55,280
context of where that data came from

496
00:20:59,830 --> 00:20:57,280
and so all of our other instruments like

497
00:21:02,070 --> 00:20:59,840
rimfax our ground penetrating radar

498
00:21:03,830 --> 00:21:02,080
meta our weather station that's going to

499
00:21:05,110 --> 00:21:03,840
understand humidity and pressure and

500
00:21:07,510 --> 00:21:05,120
that sort of thing

501
00:21:08,789 --> 00:21:07,520
um mass cam z that's kind of like the

502
00:21:10,549 --> 00:21:08,799
eyes of the rover

503
00:21:12,630 --> 00:21:10,559
all of these instruments are really

504
00:21:14,950 --> 00:21:12,640
contributing to understand

505
00:21:16,310 --> 00:21:14,960
the context of the samples that we take

506
00:21:18,390 --> 00:21:16,320
and i don't want to forget moxie because

507
00:21:20,310 --> 00:21:18,400
i didn't mention moxie but moxie

508
00:21:22,630 --> 00:21:20,320
is going to help us with a with a

509
00:21:27,750 --> 00:21:22,640
separate big goal but i'll let joby uh

510
00:21:31,830 --> 00:21:29,990
so the yeah these instruments they've

511
00:21:34,310 --> 00:21:31,840
been selected to try to catch

512
00:21:36,390 --> 00:21:34,320
as wide a range of data as possible so

513
00:21:37,990 --> 00:21:36,400

for example pixel and sherlock on the

514
00:21:40,710 --> 00:21:38,000
rover's robotic arm

515
00:21:42,390 --> 00:21:40,720
they were both designed to scan some uh

516
00:21:43,909 --> 00:21:42,400
the surface of a rock

517
00:21:46,310 --> 00:21:43,919
yep christine is pointing to them which

518
00:21:48,070 --> 00:21:46,320
is awesome um

519
00:21:49,990 --> 00:21:48,080
they scan the surface of a rock they're

520
00:21:51,909 --> 00:21:50,000
looking for slightly different things so

521
00:21:55,190 --> 00:21:51,919
sherlock is particularly sensitive to

522
00:21:55,669 --> 00:21:55,200
organics and the aromatic organics which

523
00:21:57,909 --> 00:21:55,679
are kind of

524
00:21:59,990 --> 00:21:57,919
made by like that can be made by living

525
00:22:00,710 --> 00:22:00,000
things so for example the nucleobases of

526
00:22:03,510 --> 00:22:00,720
dna

527
00:22:05,110 --> 00:22:03,520
are aromatic organic molecules so

528
00:22:06,630 --> 00:22:05,120
sherlock is particularly sensitive to

529
00:22:07,750 --> 00:22:06,640
those it can detect them down to one

530
00:22:09,830 --> 00:22:07,760
part per million

531
00:22:11,669 --> 00:22:09,840
so if there's even a trace left behind

532
00:22:11,990 --> 00:22:11,679
in the rock then we should be able to

533
00:22:13,750 --> 00:22:12,000
find

534
00:22:15,430 --> 00:22:13,760
it pixel will tell us about the

535
00:22:16,870 --> 00:22:15,440
elemental composition

536
00:22:18,549 --> 00:22:16,880
let's let's pause there for a second

537
00:22:20,710 --> 00:22:18,559
when you say aromatic when i

538
00:22:22,230 --> 00:22:20,720

you know as a as a non-specialist when i

539
00:22:24,390 --> 00:22:22,240
hear that i think

540
00:22:26,310 --> 00:22:24,400
something that smells very good is

541
00:22:29,750 --> 00:22:26,320
sherlock literally going to

542
00:22:32,149 --> 00:22:29,760
sniff out these chemicals on mars

543
00:22:33,750 --> 00:22:32,159
not exactly no so we're using we're

544
00:22:35,510 --> 00:22:33,760
using a laser to

545
00:22:36,789 --> 00:22:35,520
scan the sample and we look at the light

546
00:22:38,549 --> 00:22:36,799
that comes back from

547
00:22:41,270 --> 00:22:38,559
the rock and some of that light has been

548
00:22:41,750 --> 00:22:41,280
scattered or re-emitted by the molecules

549
00:22:43,909 --> 00:22:41,760
in it

550
00:22:45,430 --> 00:22:43,919
the reason why those molecules we're

551
00:22:47,270 --> 00:22:45,440
interested in are called aromatics is

552
00:22:50,149 --> 00:22:47,280
because when they were first discovered

553
00:22:51,909 --> 00:22:50,159
you know 100 200 years ago uh they were

554
00:22:52,470 --> 00:22:51,919
generally associated with like things

555
00:22:55,430 --> 00:22:52,480
particularly

556
00:22:57,270 --> 00:22:55,440
like rich smells right so a lot of these

557
00:22:58,149 --> 00:22:57,280
uh molecules have very very distinctive

558
00:22:59,350 --> 00:22:58,159
smells uh

559
00:23:00,789 --> 00:22:59,360
unfortunately some of them if you open a

560
00:23:01,990 --> 00:23:00,799
bottle in the lab everyone can

561
00:23:05,029 --> 00:23:02,000
immediately tell because

562
00:23:05,430 --> 00:23:05,039
some of them stink but they happen to be

563
00:23:09,750 --> 00:23:05,440

very

564
00:23:11,510 --> 00:23:09,760
at self-organizing they

565
00:23:12,950 --> 00:23:11,520
can be used to create interesting kind

566
00:23:15,350 --> 00:23:12,960
of chemical reactions

567
00:23:16,870 --> 00:23:15,360
so they are often the building blocks of

568
00:23:19,909 --> 00:23:16,880
molecules like dna

569
00:23:22,789 --> 00:23:19,919
also proteins so three out of the

570
00:23:24,070 --> 00:23:22,799
22 amino acids that make up all proteins

571
00:23:27,029 --> 00:23:24,080
in living things

572
00:23:28,470 --> 00:23:27,039
are aromatic so if we find a collection

573
00:23:30,070 --> 00:23:28,480
of these different aromatics all

574
00:23:32,149 --> 00:23:30,080
localized in the same place

575
00:23:33,590 --> 00:23:32,159
and they're all sufficiently chemically

576
00:23:35,430 --> 00:23:33,600
complex

577
00:23:38,070 --> 00:23:35,440
that they cannot be explained by like a

578
00:23:39,510 --> 00:23:38,080
sim like a simple geochemical process

579
00:23:41,430 --> 00:23:39,520
then we have to start considering the

580
00:23:43,269 --> 00:23:41,440
possibility that they may be

581
00:23:45,269 --> 00:23:43,279
what's left over from a biological

582
00:23:46,789 --> 00:23:45,279
process and if we did find something

583
00:23:47,430 --> 00:23:46,799
like that the first thing we would be

584
00:23:49,990 --> 00:23:47,440
doing

585
00:23:50,710 --> 00:23:50,000
would be taking a sample storing it in a

586
00:23:53,269 --> 00:23:50,720
tube

587
00:23:55,029 --> 00:23:53,279
and bringing it back to earth in i

588
00:23:57,830 --> 00:23:55,039

believe 11 years time

589
00:23:59,750 --> 00:23:57,840
because we want to do more studies so

590
00:24:01,590 --> 00:23:59,760
perseverance is like it has these

591
00:24:03,750 --> 00:24:01,600
amazing instruments that are going to

592
00:24:04,630 --> 00:24:03,760
give us a fantastic amount of contextual

593
00:24:07,590 --> 00:24:04,640
information

594
00:24:08,390 --> 00:24:07,600
but it's not it compels in comparison to

595
00:24:10,070 --> 00:24:08,400
what we can do

596
00:24:11,590 --> 00:24:10,080
on earth with all of the labs we have at

597
00:24:13,830 --> 00:24:11,600
our disposal here so the

598
00:24:15,029 --> 00:24:13,840
the main priority is if we find

599
00:24:16,789 --> 00:24:15,039
something really cool

600
00:24:18,789 --> 00:24:16,799
or really interesting or just really

601
00:24:20,789 --> 00:24:18,799
strange we're going to try and bring it

602
00:24:23,590 --> 00:24:20,799
back

603
00:24:25,590 --> 00:24:23,600
excellent so you touched on the sampling

604
00:24:26,630 --> 00:24:25,600
system of the rover the fact that this

605
00:24:29,350 --> 00:24:26,640
rover will be the

606
00:24:32,230 --> 00:24:29,360
first one uh to cache samples of the red

607
00:24:34,710 --> 00:24:32,240
planet for eventual return to earth

608
00:24:37,029 --> 00:24:34,720
whether that's in the the 2030s nasa and

609
00:24:37,830 --> 00:24:37,039
esa are still working out the plans for

610
00:24:41,110 --> 00:24:37,840
that

611
00:24:44,470 --> 00:24:41,120
and um obazi over on youtube

612
00:24:45,430 --> 00:24:44,480
um wants to know let's see is there any

613
00:24:48,549 --> 00:24:45,440

possibility

614
00:24:51,830 --> 00:24:48,559
um uh for perseverance or any

615
00:24:55,669 --> 00:24:51,840
other nasa missions to return to

616
00:24:59,269 --> 00:24:55,679
earth hmm

617
00:25:05,510 --> 00:25:02,310
for this rover right jessica correct

618
00:25:08,630 --> 00:25:05,520
unfortunately um it takes a lot of

619
00:25:10,789 --> 00:25:08,640
energy just to get the um something the

620
00:25:11,510 --> 00:25:10,799
size of perseverance to the surface of

621
00:25:14,549 --> 00:25:11,520
mars

622
00:25:16,070 --> 00:25:14,559
so to return it or even the tubes back

623
00:25:19,190 --> 00:25:16,080
to earth requires

624
00:25:21,110 --> 00:25:19,200
a lot of propellant so for this

625
00:25:21,909 --> 00:25:21,120
particular mission it's a one-way trip

626
00:25:24,390 --> 00:25:21,919
to mars

627
00:25:25,029 --> 00:25:24,400
but as we were kind of insinuating

628
00:25:26,950 --> 00:25:25,039
earlier

629
00:25:28,230 --> 00:25:26,960
there's a longer term vision of a mars

630
00:25:31,430 --> 00:25:28,240
sample return

631
00:25:31,990 --> 00:25:31,440
that would go and retrieve those sample

632
00:25:35,029 --> 00:25:32,000
tubes and

633
00:25:37,669 --> 00:25:35,039
bring them back to earth

634
00:25:39,350 --> 00:25:37,679
so yes it may take us a long time to get

635
00:25:41,669 --> 00:25:39,360
those physical samples back

636
00:25:43,029 --> 00:25:41,679
but we're going to get data a lot more

637
00:25:46,710 --> 00:25:43,039
quickly than that

638
00:25:49,669 --> 00:25:46,720

fey over on facebook wants to know

639
00:25:51,029 --> 00:25:49,679
how long between launch arrival on the

640
00:25:54,789 --> 00:25:51,039
surface

641
00:25:57,110 --> 00:25:54,799
to transmission of photos when can we

642
00:25:59,430 --> 00:25:57,120
reasonably expect those first images

643
00:26:02,390 --> 00:25:59,440
jessica

644
00:26:03,029 --> 00:26:02,400
that's a good question i actually am not

645
00:26:07,029 --> 00:26:03,039
sure

646
00:26:09,350 --> 00:26:07,039
um i could imagine it

647
00:26:11,590 --> 00:26:09,360
happening relatively quickly though we

648
00:26:13,830 --> 00:26:11,600
do have communications

649
00:26:15,430 --> 00:26:13,840
um you know during landing and then

650
00:26:19,110 --> 00:26:15,440
subsequently following that

651
00:26:21,269 --> 00:26:19,120
landing so we have good coverage um

652
00:26:22,710 --> 00:26:21,279
we have a you know a kind of slower data

653
00:26:25,590 --> 00:26:22,720
rate at

654
00:26:27,110 --> 00:26:25,600
uplinking data once we're on the surface

655
00:26:28,870 --> 00:26:27,120
of mars so it might take us a little

656
00:26:30,470 --> 00:26:28,880
while but i would say

657
00:26:32,310 --> 00:26:30,480
it shouldn't be too too long that we're

658
00:26:34,630 --> 00:26:32,320
waiting to get those images

659
00:26:35,350 --> 00:26:34,640
at least thumbnails like so smaller

660
00:26:38,149 --> 00:26:35,360
sized

661
00:26:40,470 --> 00:26:38,159
images right after we land back with the

662
00:26:42,470 --> 00:26:40,480
curiosity landing back in 2012

663
00:26:44,549 --> 00:26:42,480

i think all of us were just cautiously

664
00:26:46,070 --> 00:26:44,559
optimistic that we were gonna get photos

665
00:26:47,430 --> 00:26:46,080
and the thumbnails came almost

666
00:26:49,830 --> 00:26:47,440
immediately so i hope

667
00:26:51,430 --> 00:26:49,840
curiosity has not set too high of a

668
00:26:53,830 --> 00:26:51,440
unreasonable bar

669
00:26:55,750 --> 00:26:53,840
for what we're gonna see on landing day

670
00:26:57,190 --> 00:26:55,760
but i'm i'm skipping a few steps we've

671
00:27:01,590 --> 00:26:57,200
got to get this rover

672
00:27:05,430 --> 00:27:01,600
launched and to mars first um

673
00:27:08,630 --> 00:27:05,440
and then and then over to jezreel crater

674
00:27:09,350 --> 00:27:08,640
so um here's a question from charlie on

675
00:27:11,510 --> 00:27:09,360
twitter

676
00:27:14,390 --> 00:27:11,520
uh for you joby how did you pick the

677
00:27:21,190 --> 00:27:17,110
i wasn't involved in the decision that's

678
00:27:25,269 --> 00:27:22,950
no unfortunate but it was a collective

679
00:27:25,909 --> 00:27:25,279
decision made by hundreds of scientists

680
00:27:27,190 --> 00:27:25,919
who are

681
00:27:29,590 --> 00:27:27,200
obviously like miles scientists

682
00:27:32,070 --> 00:27:29,600
interested in invested in the mission

683
00:27:33,430 --> 00:27:32,080
and the general exploration of mars so

684
00:27:35,430 --> 00:27:33,440
they had a number of sites to choose

685
00:27:37,990 --> 00:27:35,440
from jezreel crater was

686
00:27:39,430 --> 00:27:38,000
was selected because uh we can see from

687
00:27:42,389 --> 00:27:39,440
orbital imagery

688
00:27:43,669 --> 00:27:42,399

that uh there it appears to appears to

689
00:27:45,669 --> 00:27:43,679
have been a lake

690
00:27:47,029 --> 00:27:45,679
a roughly three three and a half billion

691
00:27:49,990 --> 00:27:47,039
years ago it looks like there

692
00:27:51,669 --> 00:27:50,000
it was a lake roughly 250 meters deep so

693
00:27:52,630 --> 00:27:51,679
there was liquid water on the surface of

694
00:27:55,110 --> 00:27:52,640
mars at one point

695
00:27:56,310 --> 00:27:55,120
and what's more we can see a river

696
00:27:58,950 --> 00:27:56,320
channel that traveled

697
00:28:00,470 --> 00:27:58,960
into the lake and you can see a delta a

698
00:28:01,909 --> 00:28:00,480
river delta that'd be left behind so

699
00:28:02,789 --> 00:28:01,919
that's kind of like a big fan of

700
00:28:04,470 --> 00:28:02,799
deposits

701
00:28:06,389 --> 00:28:04,480
of like minerals like clays and

702
00:28:07,990 --> 00:28:06,399
carbonates that were carried by that

703
00:28:10,789 --> 00:28:08,000
water and dropped

704
00:28:11,510 --> 00:28:10,799
um as the river entered the lake so

705
00:28:14,389 --> 00:28:11,520
obviously there's

706
00:28:16,230 --> 00:28:14,399
we can't see any liquid water now but we

707
00:28:18,630 --> 00:28:16,240
can see these kind of remnants of what

708
00:28:20,549 --> 00:28:18,640
used to be a flowing water on mars

709
00:28:21,669 --> 00:28:20,559
and those deposits those clays those

710
00:28:23,110 --> 00:28:21,679
carbonates we

711
00:28:24,950 --> 00:28:23,120
you know are based on what we've seen on

712
00:28:26,470 --> 00:28:24,960
earth they tend to be very very rich in

713
00:28:28,950 --> 00:28:26,480

organic material so anything that was

714
00:28:31,269 --> 00:28:28,960
living in that water could be preserved

715
00:28:33,029 --> 00:28:31,279
over billions of years in those deposits

716
00:28:34,630 --> 00:28:33,039
so by landing in jezreel crater we're

717
00:28:36,470 --> 00:28:34,640
getting immediate access

718
00:28:38,630 --> 00:28:36,480
to effectively a geological and

719
00:28:41,430 --> 00:28:38,640
potentially an astrobiological

720
00:28:42,789 --> 00:28:41,440
record of what was going on in that

721
00:28:44,230 --> 00:28:42,799
water system and that's going to be

722
00:28:46,470 --> 00:28:44,240
incredibly invaluable

723
00:28:48,149 --> 00:28:46,480
for understanding the history of mars

724
00:28:50,470 --> 00:28:48,159
and especially things like

725
00:28:51,190 --> 00:28:50,480
was mars habitable three billion years

726
00:28:53,350 --> 00:28:51,200
ago

727
00:28:55,350 --> 00:28:53,360
did something ever evolve and live in

728
00:28:57,669 --> 00:28:55,360
that water

729
00:28:59,590 --> 00:28:57,679
three billion years can leave a lot of

730
00:29:02,549 --> 00:28:59,600
sediments behind

731
00:29:03,590 --> 00:29:02,559
and i have a very practical question for

732
00:29:06,630 --> 00:29:03,600
you christina

733
00:29:10,549 --> 00:29:06,640
from edgar on youtube who wants to know

734
00:29:14,310 --> 00:29:12,470
wow that's actually a good question i

735
00:29:15,350 --> 00:29:14,320
don't know if you know it jessica i do

736
00:29:18,310 --> 00:29:15,360
know though

737
00:29:20,470 --> 00:29:18,320
um that we have the ability to image the

738
00:29:21,510 --> 00:29:20,480

subsurface of mars i kind of alluded to

739
00:29:23,110 --> 00:29:21,520
this earlier

740
00:29:25,430 --> 00:29:23,120
uh with rimfacts and so you could

741
00:29:27,430 --> 00:29:25,440
imagine rimfax giving us some context of

742
00:29:29,350 --> 00:29:27,440
what's underneath the subsurface

743
00:29:30,950 --> 00:29:29,360
and then the coring team coming in and

744
00:29:32,710 --> 00:29:30,960
taking some samples but

745
00:29:34,789 --> 00:29:32,720
i don't think it's quite deep we've sent

746
00:29:37,029 --> 00:29:34,799
other landers like insight for example

747
00:29:38,549 --> 00:29:37,039
that we're able to penetrate much deeper

748
00:29:41,430 --> 00:29:38,559
we're really trying to just get right

749
00:29:43,669 --> 00:29:41,440
below that subsurface

750
00:29:45,029 --> 00:29:43,679
perseverance's drill is five centimeters

751
00:29:47,350 --> 00:29:45,039
i believe ah

752
00:29:49,909 --> 00:29:47,360
there we go it's both the same on the

753
00:29:51,990 --> 00:29:49,919
same order as the curiosity rover

754
00:29:54,149 --> 00:29:52,000
which is currently up there on mars i

755
00:29:55,350 --> 00:29:54,159
think it's getting a final taste of the

756
00:29:58,870 --> 00:29:55,360
clay unit

757
00:30:01,029 --> 00:29:58,880
right now so um we love all our robots

758
00:30:01,590 --> 00:30:01,039
right it's not just about perseverance

759
00:30:05,190 --> 00:30:01,600
and

760
00:30:07,990 --> 00:30:05,200
um

761
00:30:08,789 --> 00:30:08,000
my goodness uh we've got so many people

762
00:30:11,830 --> 00:30:08,799
around the world

763
00:30:15,110 --> 00:30:11,840

working on this who are so excited

764
00:30:17,590 --> 00:30:15,120
and um i just want to make sure

765
00:30:19,430 --> 00:30:17,600
that everybody has really just had a

766
00:30:20,149 --> 00:30:19,440
chance to uh to get to know all of you

767
00:30:23,110 --> 00:30:20,159
today

768
00:30:23,510 --> 00:30:23,120
to see you and before we wrap up this

769
00:30:26,389 --> 00:30:23,520
show

770
00:30:32,310 --> 00:30:26,399
i want to ask um how are you feeling how

771
00:30:36,070 --> 00:30:33,350
i don't think i'm going to get much

772
00:30:38,070 --> 00:30:36,080
sleep tonight

773
00:30:39,909 --> 00:30:38,080
so not much sleep from joby jessica how

774
00:30:42,549 --> 00:30:39,919
are you doing

775
00:30:44,710 --> 00:30:42,559
i i'm i'm doing okay actually i have a

776
00:30:47,430 --> 00:30:44,720
strange sense of calm even though

777
00:30:48,789 --> 00:30:47,440
uh tomorrow we're going to be on console

778
00:30:51,190 --> 00:30:48,799
and i think the biggest thing is i'm

779
00:30:53,750 --> 00:30:51,200
just trying to shift my sleep hours

780
00:30:54,470 --> 00:30:53,760
so that i when i wake up at you know

781
00:30:57,110 --> 00:30:54,480
midnight

782
00:30:58,789 --> 00:30:57,120
and go into work i won't be completely

783
00:31:02,070 --> 00:30:58,799
dunked

784
00:31:05,350 --> 00:31:02,080
but i'm excited i'm ready

785
00:31:07,190 --> 00:31:05,360
and how about you christina i'm super

786
00:31:07,509 --> 00:31:07,200
excited because with the launch it means

787
00:31:09,110 --> 00:31:07,519
that

788
00:31:11,269 --> 00:31:09,120

it's time to do more testing to get

789
00:31:13,750 --> 00:31:11,279
ready for the surface of mars so

790
00:31:16,830 --> 00:31:13,760
there's a lot of work to do all about

791
00:31:20,710 --> 00:31:16,840
job security for you then right

792
00:31:25,029 --> 00:31:23,190
i want to thank you all for your time

793
00:31:26,470 --> 00:31:25,039
and for everybody watching online thank

794
00:31:28,630 --> 00:31:26,480
you for the fantastic

795
00:31:29,590 --> 00:31:28,640
questions we hope that you will be

796
00:31:32,389 --> 00:31:29,600
watching

797
00:31:33,830 --> 00:31:32,399
live with us as perseverance lifts off

798
00:31:37,029 --> 00:31:33,840
for the red planet

799
00:31:39,909 --> 00:31:37,039
our launch coverage will start at um oh

800
00:31:40,710 --> 00:31:39,919
dark 30 here in uh in the pacific time

801
00:31:42,870 --> 00:31:40,720
zone

802
00:31:45,110 --> 00:31:42,880
uh we'll be going live at 4 00 a.m

803
00:31:49,190 --> 00:31:45,120
pacific 7 a.m eastern

804
00:31:51,110 --> 00:31:49,200
1100 utc with liftoff expected about

805
00:31:53,430 --> 00:31:51,120
50 minutes later and we will be

806
00:31:56,630 --> 00:31:53,440
streaming live on nasa television

807
00:32:00,230 --> 00:31:56,640
uh the nasa website youtube dailymotion

808
00:32:01,669 --> 00:32:00,240
linkedin facebook twitter and twitch

809
00:32:03,909 --> 00:32:01,679
don't forget that you can follow the

810
00:32:06,389 --> 00:32:03,919
rover at nasa persevere

811
00:32:07,430 --> 00:32:06,399
on twitter and facebook all of us here

812
00:32:09,590 --> 00:32:07,440
at jpl

813
00:32:11,509 --> 00:32:09,600

nasa jpl wherever you get your social

814
00:32:14,470 --> 00:32:11,519
and all of nasa's missions

815
00:32:15,990 --> 00:32:14,480
at nasa don't forget to use the hashtag

816
00:32:17,430 --> 00:32:16,000
countdown to mars to join the