NASA'S INSIGHT PREPARES FOR END OF MISSION

EXPERT Q&A

1
00:00:05,990 --> 00:00:03,110
all right so what is next for nasa's

2
00:00:07,829 --> 00:00:06,000
mars insight lander we announced last

3
00:00:10,629 --> 00:00:07,839
week that the lander will head into

4
00:00:13,350 --> 00:00:10,639
retirement in just a couple months as

5
00:00:15,910 --> 00:00:13,360
the solar power winds down but until

6
00:00:17,670 --> 00:00:15,920
then insight is still hunting mars

7
00:00:20,630 --> 00:00:17,680
quakes one of its main goals since

8
00:00:23,590 --> 00:00:20,640
landing on the red planet in 2018

9
00:00:25,750 --> 00:00:23,600
and i'm raquel villanueva here at nasa's

10
00:00:28,070 --> 00:00:25,760
jet propulsion laboratory we are going

11
00:00:30,310 --> 00:00:28,080
to give you a behind-the-scenes look at

12
00:00:33,030 --> 00:00:30,320
a really unique place on lab which is

13
00:00:35,110 --> 00:00:33,040

this mars testing area

14
00:00:37,750 --> 00:00:35,120
and we'll also be answering some of your

15
00:00:39,910 --> 00:00:37,760
questions about the insight lander now

16
00:00:43,190 --> 00:00:39,920
we're coming to you live from the in

17
00:00:46,470 --> 00:00:43,200
situ instrument laboratory it's a space

18
00:00:48,630 --> 00:00:46,480
designed like the surfs of mars so

19
00:00:52,229 --> 00:00:48,640
engineers can conduct tests under

20
00:00:54,950 --> 00:00:52,239
similar conditions and behind us that is

21
00:00:57,110 --> 00:00:54,960
foresight it is insights earth twin used

22
00:00:59,430 --> 00:00:57,120
for testing the model is an exact

23
00:01:01,430 --> 00:00:59,440
duplicate of insight minus a few things

24
00:01:03,910 --> 00:01:01,440
that have been removed like the solar

25
00:01:05,509 --> 00:01:03,920
panels but it gets the name foresight

26
00:01:07,990 --> 00:01:05,519
because engineers practice doing

27
00:01:11,190 --> 00:01:08,000
everything the lander will do on mars

28
00:01:13,350 --> 00:01:11,200
here first and we are joined by two

29
00:01:16,630 --> 00:01:13,360
members of the insight team

30
00:01:18,710 --> 00:01:16,640
testbed lead renee mishra and project

31
00:01:20,469 --> 00:01:18,720
scientist mark panning they'll be

32
00:01:22,310 --> 00:01:20,479
answering some of your questions about

33
00:01:24,870 --> 00:01:22,320
insight what they've learned since it

34
00:01:26,710 --> 00:01:24,880
landed on mars in 2018 and what the

35
00:01:28,710 --> 00:01:26,720
future of the mission looks like now

36
00:01:31,030 --> 00:01:28,720
that we know the power will likely run

37
00:01:32,870 --> 00:01:31,040
out in the next couple months

38
00:01:35,109 --> 00:01:32,880

we want people to get familiar with the

39
00:01:37,749 --> 00:01:35,119
insight lander so could you give people

40
00:01:39,590 --> 00:01:37,759
a quick recap of the mission sure and

41
00:01:41,670 --> 00:01:39,600
it's um fortunately it's much easier to

42
00:01:45,670 --> 00:01:41,680
fix things on earth than on mars

43
00:01:47,749 --> 00:01:45,680
um so uh basically as i was starting to

44
00:01:49,350 --> 00:01:47,759
say earlier insight's really the first

45
00:01:51,109 --> 00:01:49,360
mission that's been designed to look

46
00:01:52,389 --> 00:01:51,119
inside of mars uh we've had lots of

47
00:01:54,149 --> 00:01:52,399
missions that have looked at the surface

48
00:01:55,670 --> 00:01:54,159
in the atmosphere but insight's really

49
00:01:57,350 --> 00:01:55,680
designed to see what's happening in the

50
00:01:59,670 --> 00:01:57,360
deep interior all the way down to its

51
00:02:01,590 --> 00:01:59,680
core and the main tool we use for that

52
00:02:04,469 --> 00:02:01,600
is looking at mars quakes which are

53
00:02:08,070 --> 00:02:04,479
recorded with a seismometer if you look

54
00:02:09,749 --> 00:02:08,080
to the right this is a model of the the

55
00:02:11,589 --> 00:02:09,759
seismometer and we'll we'll talk more

56
00:02:13,910 --> 00:02:11,599
about that in a bit uh but that's

57
00:02:14,949 --> 00:02:13,920
actually what's used to measure mars

58
00:02:17,350 --> 00:02:14,959
quakes

59
00:02:18,710 --> 00:02:17,360
and we've measured over 1300 of them

60
00:02:20,949 --> 00:02:18,720
through the mission and we've used those

61
00:02:22,710 --> 00:02:20,959
to look at the interior we also have a a

62
00:02:25,510 --> 00:02:22,720
couple other key instruments that are

63
00:02:27,910 --> 00:02:25,520

using other ways of looking inside

64
00:02:30,470 --> 00:02:27,920
by attempting to measure heat flow or by

65
00:02:32,630 --> 00:02:30,480
using radio science to measure really

66
00:02:34,309 --> 00:02:32,640
small wobbles of the planet

67
00:02:36,309 --> 00:02:34,319
great thank you mark and if you're just

68
00:02:38,390 --> 00:02:36,319
tuning in again we are answering some

69
00:02:40,229 --> 00:02:38,400
questions about the mars insight lander

70
00:02:42,309 --> 00:02:40,239
if you have a question use the ask nasa

71
00:02:44,390 --> 00:02:42,319
hashtag or drop in the comments below

72
00:02:47,190 --> 00:02:44,400
and we'll be getting to them in a bit

73
00:02:49,750 --> 00:02:47,200
but now to kind of describe the in situ

74
00:02:52,390 --> 00:02:49,760
instrument laboratory i'd like to have

75
00:02:53,910 --> 00:02:52,400
prenay come over here and do

76
00:02:55,509 --> 00:02:53,920
we'll explain that little dance you have

77
00:02:58,470 --> 00:02:55,519
to do with the instruments before but

78
00:03:00,390 --> 00:02:58,480
can you explain why this type of room is

79
00:03:02,630 --> 00:03:00,400
important for mars missions absolutely

80
00:03:04,309 --> 00:03:02,640
so the activities we complete on mars

81
00:03:06,309 --> 00:03:04,319
with both our landers and our rovers are

82
00:03:08,710 --> 00:03:06,319
very complex and we want to give them

83
00:03:10,710 --> 00:03:08,720
the best chance of success so in a

84
00:03:13,110 --> 00:03:10,720
facility like this with a test bed like

85
00:03:14,470 --> 00:03:13,120
this we actually test all the complex

86
00:03:16,550 --> 00:03:14,480
activities that we're going to perform

87
00:03:18,630 --> 00:03:16,560
on mars in here first we'll write a

88
00:03:20,470 --> 00:03:18,640

sequence we'll test it out here in this

89
00:03:22,149 --> 00:03:20,480
facility we'll see what went right what

90
00:03:23,910 --> 00:03:22,159
went wrong make some tweaks and

91
00:03:25,110 --> 00:03:23,920
eventually when it goes right in here

92
00:03:27,110 --> 00:03:25,120
we'll send it to mars so that it

93
00:03:28,710 --> 00:03:27,120
executes successfully there and i had a

94
00:03:31,110 --> 00:03:28,720
question about kind of everything we're

95
00:03:34,309 --> 00:03:31,120
stepping on this gravel like why does

96
00:03:36,710 --> 00:03:34,319
this have to be here for the uh

97
00:03:38,070 --> 00:03:36,720
sure so what this actually is if you

98
00:03:39,750 --> 00:03:38,080
take a look most people might think

99
00:03:42,149 --> 00:03:39,760
they're just some rocks you find outside

100
00:03:43,990 --> 00:03:42,159
but this is actually crushed unprocessed

101
00:03:46,789 --> 00:03:44,000
garnet and when you think of garnet you

102
00:03:48,309 --> 00:03:46,799
think of jewelry but this is the version

103
00:03:49,990 --> 00:03:48,319
before it turns into that so if you

104
00:03:51,589 --> 00:03:50,000
actually pick some pieces out and hold

105
00:03:53,589 --> 00:03:51,599
them into the light you can see little

106
00:03:55,990 --> 00:03:53,599
glints of red for the jewelry that they

107
00:03:57,990 --> 00:03:56,000
could one day become in here we use them

108
00:04:00,550 --> 00:03:58,000
as our practice deployment surface for

109
00:04:01,830 --> 00:04:00,560
insights so we have tiny rock polisher

110
00:04:04,949 --> 00:04:01,840
that's right that's right just a little

111
00:04:08,070 --> 00:04:04,959
bit of jewelry here and then uh also why

112
00:04:11,030 --> 00:04:08,080
are you both clipped into the foresight

113
00:04:12,949 --> 00:04:11,040

right now so foresight and most test

114
00:04:14,949 --> 00:04:12,959
beds have very sensitive electronics

115
00:04:17,749 --> 00:04:14,959
both to temperature and things like

116
00:04:19,830 --> 00:04:17,759
electrostatic discharge and so to ensure

117
00:04:22,069 --> 00:04:19,840
that myself or mark or anyone who's

118
00:04:24,310 --> 00:04:22,079
close to these electronics doesn't cause

119
00:04:25,830 --> 00:04:24,320
any accidental electrostatic discharge

120
00:04:28,469 --> 00:04:25,840
we use these things called grounding

121
00:04:30,150 --> 00:04:28,479
straps connect to a ground wire here to

122
00:04:32,550 --> 00:04:30,160
ensure that there's no chance that we

123
00:04:34,870 --> 00:04:32,560
can danger these electronics same for

124
00:04:36,390 --> 00:04:34,880
the ac that was mentioned earlier

125
00:04:37,830 --> 00:04:36,400
these electronics are sensitive to

126
00:04:39,909 --> 00:04:37,840
temperature we don't want it to get too

127
00:04:41,909 --> 00:04:39,919
hot in here otherwise that might damage

128
00:04:43,590 --> 00:04:41,919
it so we have this very loud ac going to

129
00:04:45,590 --> 00:04:43,600
ensure that it stays cool in this room

130
00:04:48,230 --> 00:04:45,600
all right so if you see them do a little

131
00:04:49,830 --> 00:04:48,240
dance that's why they're keeping the uh

132
00:04:51,990 --> 00:04:49,840
the foresight safe and speaking of

133
00:04:54,550 --> 00:04:52,000
foresight can you kind of go through

134
00:04:56,710 --> 00:04:54,560
some of the parts that we see here sure

135
00:04:58,710 --> 00:04:56,720
so if we start from a far view what we

136
00:05:00,710 --> 00:04:58,720
have here is foresight's deck it's the

137
00:05:02,150 --> 00:05:00,720
same size as insights deck and as you

138
00:05:03,749 --> 00:05:02,160

mentioned before we just don't have

139
00:05:04,469 --> 00:05:03,759
solar panels on it

140
00:05:08,870 --> 00:05:04,479
the

141
00:05:11,909 --> 00:05:08,880
see in photos is our

142
00:05:14,790 --> 00:05:11,919
instrument deployment arm the idea

143
00:05:16,469 --> 00:05:14,800
so this arm is what was used to deploy

144
00:05:19,350 --> 00:05:16,479
all our deployables onto the surface of

145
00:05:20,790 --> 00:05:19,360
mars there are two cameras on insight

146
00:05:23,350 --> 00:05:20,800
and so we have two cameras here on

147
00:05:25,189 --> 00:05:23,360
foresight the first one is the idc

148
00:05:27,909 --> 00:05:25,199
the instrument deployment camera and

149
00:05:29,430 --> 00:05:27,919
that's that red box attached to the arm

150
00:05:31,189 --> 00:05:29,440
and then we have a second camera we'll

151
00:05:33,430 --> 00:05:31,199
have to swing around a little bit but we

152
00:05:35,590 --> 00:05:33,440
have a second camera there's a red box

153
00:05:37,749 --> 00:05:35,600
to my right that is our instrument

154
00:05:38,390 --> 00:05:37,759
context camera or icc so when you see

155
00:05:40,310 --> 00:05:38,400
the

156
00:05:42,629 --> 00:05:40,320
fixed landscape images come back from

157
00:05:44,629 --> 00:05:42,639
insight that's from the icc and anytime

158
00:05:46,390 --> 00:05:44,639
you see images of the deck or close-ups

159
00:05:49,029 --> 00:05:46,400
of the instruments that's coming from

160
00:05:51,270 --> 00:05:49,039
our idc speaking of instruments mark had

161
00:05:54,150 --> 00:05:51,280
already mentioned the seismometer to my

162
00:05:55,909 --> 00:05:54,160
right which is this orange hexagon here

163
00:05:57,749 --> 00:05:55,919

in our photos what you typically see is

164
00:06:00,629 --> 00:05:57,759
this white dome called the wind and

165
00:06:02,390 --> 00:06:00,639
thermal shield abbreviated to wts this

166
00:06:04,469 --> 00:06:02,400
is placed on top of the seismometer to

167
00:06:06,870 --> 00:06:04,479
ensure we don't have any noise or less

168
00:06:09,029 --> 00:06:06,880
noise in our data taken from the

169
00:06:11,990 --> 00:06:09,039
seismometer and here

170
00:06:14,710 --> 00:06:12,000
we have a model of the hp3 which is our

171
00:06:16,230 --> 00:06:14,720
the mole the penetrator uh and so these

172
00:06:18,469 --> 00:06:16,240
are the three items that we practice

173
00:06:19,430 --> 00:06:18,479
deploying in this testbed and what has

174
00:06:21,350 --> 00:06:19,440
kind of been some of the most

175
00:06:23,909 --> 00:06:21,360
significant and important tests you've

176
00:06:26,150 --> 00:06:23,919
done since insight landed the most

177
00:06:28,309 --> 00:06:26,160
important test we did was practicing

178
00:06:29,909 --> 00:06:28,319
these deployments before we landed we

179
00:06:31,830 --> 00:06:29,919
weren't sure what the terrain would look

180
00:06:34,070 --> 00:06:31,840
like we could have a tilt

181
00:06:36,550 --> 00:06:34,080
we could have rocks in our workspace so

182
00:06:38,390 --> 00:06:36,560
in this room we would add rocks to our

183
00:06:40,710 --> 00:06:38,400
field we would set up boards with

184
00:06:42,550 --> 00:06:40,720
different tilts up to 15 degrees and

185
00:06:43,990 --> 00:06:42,560
these items would be up here on the deck

186
00:06:45,909 --> 00:06:44,000
and we would use the robotic arm and

187
00:06:47,350 --> 00:06:45,919
practice lifting them and putting them

188
00:06:49,270 --> 00:06:47,360

onto the surface we wanted to make sure

189
00:06:50,790 --> 00:06:49,280
we had good accuracy and good precision

190
00:06:52,309 --> 00:06:50,800
so when the scientists told us where

191
00:06:53,670 --> 00:06:52,319
they wanted these on the surface we

192
00:06:55,430 --> 00:06:53,680
could get them there all right and

193
00:06:57,589 --> 00:06:55,440
speaking of scientists

194
00:07:00,070 --> 00:06:57,599
mark i have some questions for you

195
00:07:02,710 --> 00:07:00,080
what have scientists learned from

196
00:07:04,390 --> 00:07:02,720
insight yeah so um

197
00:07:06,309 --> 00:07:04,400
as i said our our main mission goals

198
00:07:08,390 --> 00:07:06,319
were to look at the interior mars in

199
00:07:10,950 --> 00:07:08,400
particular we wanted to know more about

200
00:07:12,550 --> 00:07:10,960
its crust which is the rocky layer on

201
00:07:14,230 --> 00:07:12,560
the outside it's mantle which is the

202
00:07:16,550 --> 00:07:14,240
rocky layer below it and its core which

203
00:07:18,710 --> 00:07:16,560
is the metallic layer in the middle and

204
00:07:20,309 --> 00:07:18,720
uh by looking at all of those mars

205
00:07:22,790 --> 00:07:20,319
quakes we've talked about so there's

206
00:07:23,589 --> 00:07:22,800
over 1300 of them recorded we can look

207
00:07:29,589 --> 00:07:23,599
at

208
00:07:30,950 --> 00:07:29,599
insight go through the inside of mars

209
00:07:32,790 --> 00:07:30,960
and use that to figure out what's

210
00:07:35,990 --> 00:07:32,800
happening on the inside of mars so we

211
00:07:38,150 --> 00:07:36,000
can now tell how thick the crust is um

212
00:07:40,150 --> 00:07:38,160
it's not as thick as some models

213
00:07:42,070 --> 00:07:40,160

suggested before but it's uh

214
00:07:44,629 --> 00:07:42,080
it makes a lot of sense we can now tell

215
00:07:46,070 --> 00:07:44,639
how big the core is it's actually ended

216
00:07:47,670 --> 00:07:46,080
up being on the big end of our

217
00:07:49,670 --> 00:07:47,680
expectations which is actually going to

218
00:07:51,189 --> 00:07:49,680
be very interesting moving forward and

219
00:07:53,909 --> 00:07:51,199
trying to understand the science of how

220
00:07:55,749 --> 00:07:53,919
mars formed and evolved if it's big it's

221
00:07:57,990 --> 00:07:55,759
also less dense and that tells you stuff

222
00:07:59,029 --> 00:07:58,000
about the kinds of stuff inside the

223
00:08:00,869 --> 00:07:59,039
court

224
00:08:03,189 --> 00:08:00,879
we're also really interested in how

225
00:08:04,629 --> 00:08:03,199
active mars is all those mars quakes we

226
00:08:06,070 --> 00:08:04,639
recorded we need to know why they're

227
00:08:07,510 --> 00:08:06,080
happening and where they're happening

228
00:08:09,189 --> 00:08:07,520
and some of the most interesting stuff

229
00:08:12,070 --> 00:08:09,199
is that many of those quakes happen in

230
00:08:14,309 --> 00:08:12,080
an area we call cerberus fosse which

231
00:08:15,749 --> 00:08:14,319
geologically speaking is very young in

232
00:08:17,589 --> 00:08:15,759
terms of volcanoes now when i say

233
00:08:19,589 --> 00:08:17,599
geologically young it's

234
00:08:23,510 --> 00:08:19,599
less than 10 million years old

235
00:08:25,110 --> 00:08:23,520
but we we know has steep sides on its

236
00:08:26,790 --> 00:08:25,120
features that have rock falls that go

237
00:08:28,790 --> 00:08:26,800
down them and we suspected going into

238
00:08:30,869 --> 00:08:28,800

the mission that we would see marsquakes

239
00:08:33,350 --> 00:08:30,879
there and it turns out we did see mars

240
00:08:35,350 --> 00:08:33,360
quakes there um and also many marsquakes

241
00:08:36,870 --> 00:08:35,360
uh all around the the planet so there's

242
00:08:38,230 --> 00:08:36,880
there's been a lot of uh really

243
00:08:40,389 --> 00:08:38,240
interesting science to come out and a

244
00:08:42,389 --> 00:08:40,399
lot of science to come yeah speaking of

245
00:08:45,190 --> 00:08:42,399
science to come will you be able to use

246
00:08:47,350 --> 00:08:45,200
the data that you have received and

247
00:08:50,630 --> 00:08:47,360
continue to receive in the future

248
00:08:53,430 --> 00:08:50,640
absolutely so um i i like to reference

249
00:08:55,030 --> 00:08:53,440
back to the apollo missions so they

250
00:08:56,790 --> 00:08:55,040
landed seismometers on the moon that

251
00:08:59,590 --> 00:08:56,800
operated after the astronauts left and

252
00:09:01,910 --> 00:08:59,600
they kept operating until 1977

253
00:09:04,230 --> 00:09:01,920
um but then they got turned off in 1977

254
00:09:06,710 --> 00:09:04,240
but people are still making studies on

255
00:09:07,430 --> 00:09:06,720
those quakes today

256
00:09:08,949 --> 00:09:07,440
and

257
00:09:10,389 --> 00:09:08,959
there's every reason to think people are

258
00:09:11,750 --> 00:09:10,399
still going to be studying mars quakes

259
00:09:13,990 --> 00:09:11,760
from insight

260
00:09:16,790 --> 00:09:14,000
for decades to come in fact all the data

261
00:09:19,110 --> 00:09:16,800
is publicly available um

262
00:09:20,790 --> 00:09:19,120
with a slight delay but most of the most

263
00:09:22,070 --> 00:09:20,800

of the data for the mission you can just

264
00:09:23,750 --> 00:09:22,080
download from the sites that

265
00:09:25,590 --> 00:09:23,760
seismologists work from whether you're

266
00:09:27,350 --> 00:09:25,600
on the science team or not

267
00:09:29,430 --> 00:09:27,360
lots of science years ahead and i do

268
00:09:32,310 --> 00:09:29,440
like the aspect that the public can also

269
00:09:33,990 --> 00:09:32,320
access it as well and we are getting

270
00:09:36,389 --> 00:09:34,000
some viewer questions in so if you're

271
00:09:37,829 --> 00:09:36,399
just tuning in we are asking some

272
00:09:39,910 --> 00:09:37,839
questions about insight and won't be

273
00:09:42,310 --> 00:09:39,920
answering your questions use the hashtag

274
00:09:46,070 --> 00:09:42,320
asknasa or drop them in the comments

275
00:09:48,630 --> 00:09:46,080
below and first off for mark we have

276
00:09:49,990 --> 00:09:48,640
roshana who asks will there be a future

277
00:09:54,070 --> 00:09:50,000
mission that will follow up in the

278
00:09:57,030 --> 00:09:54,080
discoveries made by the insight lander

279
00:10:00,310 --> 00:09:57,040
the short answer is i don't know

280
00:10:02,710 --> 00:10:00,320
those decisions are are made by nasa

281
00:10:04,150 --> 00:10:02,720
and so i have ideas for some great

282
00:10:05,750 --> 00:10:04,160
things we could do it would be great to

283
00:10:07,829 --> 00:10:05,760
have a mission someday that went to

284
00:10:10,389 --> 00:10:07,839
servers fosa and looked at mars quakes

285
00:10:11,590 --> 00:10:10,399
um and there are uh i have certainly

286
00:10:12,710 --> 00:10:11,600
going to be

287
00:10:14,790 --> 00:10:12,720
um

288
00:10:16,230 --> 00:10:14,800

people that are proposing missions to go

289
00:10:18,550 --> 00:10:16,240
back to mars but

290
00:10:19,750 --> 00:10:18,560
uh we can't predict exactly what's going

291
00:10:22,389 --> 00:10:19,760
to happen

292
00:10:24,069 --> 00:10:22,399
and i have another question coming in

293
00:10:25,590 --> 00:10:24,079
from cynical led

294
00:10:27,990 --> 00:10:25,600
they i think this is going to be for

295
00:10:30,470 --> 00:10:28,000
prenate what happens if the solar arrays

296
00:10:33,030 --> 00:10:30,480
are cleaned off by wind will you bring

297
00:10:34,949 --> 00:10:33,040
the mission out of retirement

298
00:10:36,150 --> 00:10:34,959
so i can't speak to the last part of the

299
00:10:38,389 --> 00:10:36,160
question about bringing it out of

300
00:10:40,389 --> 00:10:38,399
retirement that's a very broad question

301
00:10:43,030 --> 00:10:40,399
if we could be able to do that but

302
00:10:44,870 --> 00:10:43,040
if there was a cleaning event on the

303
00:10:47,590 --> 00:10:44,880
solar panels we would expect to have

304
00:10:49,110 --> 00:10:47,600
more power in our batteries and insight

305
00:10:51,030 --> 00:10:49,120
would be able to operate for a longer

306
00:10:52,550 --> 00:10:51,040
amount of time when that happens and if

307
00:10:53,430 --> 00:10:52,560
that happens unfortunately it's not up

308
00:10:55,590 --> 00:10:53,440
to us

309
00:10:57,910 --> 00:10:55,600
okay i would i would like to follow up

310
00:10:59,910 --> 00:10:57,920
on that real quick so one thing we do

311
00:11:02,870 --> 00:10:59,920
know about how the spacecraft is

312
00:11:04,870 --> 00:11:02,880
designed is that

313
00:11:06,389 --> 00:11:04,880

at some point it won't deliver enough

314
00:11:07,829 --> 00:11:06,399
energy to keep the batteries charged up

315
00:11:10,550 --> 00:11:07,839
and we'll stop communicating with it we

316
00:11:11,670 --> 00:11:10,560
expect that to happen sometime this year

317
00:11:14,389 --> 00:11:11,680
but

318
00:11:17,590 --> 00:11:14,399
if in the future the solar panels were

319
00:11:19,509 --> 00:11:17,600
were cleaned off it's the spacecraft

320
00:11:20,710 --> 00:11:19,519
design that it would then start charging

321
00:11:22,550 --> 00:11:20,720
up the batteries

322
00:11:25,350 --> 00:11:22,560
and it would

323
00:11:27,430 --> 00:11:25,360
start to try to communicate with earth

324
00:11:29,670 --> 00:11:27,440
and there's a chance that we could hear

325
00:11:32,150 --> 00:11:29,680
it again and bring it back it's

326
00:11:35,509 --> 00:11:32,160
possible it's designed to be able to do

327
00:11:38,069 --> 00:11:35,519
that but once again that's depends on

328
00:11:39,110 --> 00:11:38,079
what mars does and so we can't predict

329
00:11:40,710 --> 00:11:39,120
what's going to happen but the

330
00:11:43,350 --> 00:11:40,720
spacecraft is designed to be able to

331
00:11:46,710 --> 00:11:43,360
recover from its battery being drained

332
00:11:49,350 --> 00:11:46,720
that's a nice hopeful answer so uh we

333
00:11:52,550 --> 00:11:49,360
have some people commenting on what they

334
00:11:54,310 --> 00:11:52,560
see behind us and how foresight is kind

335
00:11:57,269 --> 00:11:54,320
of on these blocks

336
00:11:59,030 --> 00:11:57,279
could you kind of explain why that is

337
00:12:01,509 --> 00:11:59,040
sure so

338
00:12:03,030 --> 00:12:01,519

as most people know insight is a lander

339
00:12:05,190 --> 00:12:03,040
so it does not have any wheels and it

340
00:12:07,269 --> 00:12:05,200
doesn't move so one of the things we

341
00:12:09,829 --> 00:12:07,279
like to test in this room using

342
00:12:12,150 --> 00:12:09,839
foresight is besides the deployments is

343
00:12:13,990 --> 00:12:12,160
when the hp3 mole anomaly occurred we

344
00:12:16,310 --> 00:12:14,000
wanted to ensure that we could test

345
00:12:18,389 --> 00:12:16,320
every possible solution in the space

346
00:12:21,350 --> 00:12:18,399
what we actually did was we had brought

347
00:12:23,190 --> 00:12:21,360
in the flight spare for our mole brought

348
00:12:25,990 --> 00:12:23,200
it to this room here connected it to

349
00:12:27,190 --> 00:12:26,000
foresight and we set up a box in this

350
00:12:28,230 --> 00:12:27,200
space

351
00:12:30,550 --> 00:12:28,240
to give

352
00:12:32,550 --> 00:12:30,560
time and depth for the mole to actually

353
00:12:34,949 --> 00:12:32,560
penetrate if we needed to during our

354
00:12:36,550 --> 00:12:34,959
testing so we needed space downward for

355
00:12:38,310 --> 00:12:36,560
the mole to penetrate so we actually had

356
00:12:40,550 --> 00:12:38,320
to raise the lander up using these

357
00:12:41,990 --> 00:12:40,560
cinder blocks to ensure that the height

358
00:12:44,310 --> 00:12:42,000
between the deck

359
00:12:46,629 --> 00:12:44,320
the robotic arm and the mole in our

360
00:12:48,470 --> 00:12:46,639
testing area was the same as on mars to

361
00:12:50,470 --> 00:12:48,480
ensure that we were actually testing in

362
00:12:51,990 --> 00:12:50,480
a flight-like way

363
00:12:54,550 --> 00:12:52,000

it's fun to see like all these little

364
00:12:56,470 --> 00:12:54,560
parts and how they have one specific use

365
00:12:58,069 --> 00:12:56,480
in here that's right this is our play

366
00:12:58,949 --> 00:12:58,079
sandbox this is the best part about this

367
00:13:00,550 --> 00:12:58,959
job

368
00:13:02,069 --> 00:13:00,560
and we have some more questions coming

369
00:13:03,750 --> 00:13:02,079
in about the signs again if you'd like

370
00:13:05,670 --> 00:13:03,760
to ask a question about insight use the

371
00:13:06,389 --> 00:13:05,680
ask nasa

372
00:13:08,310 --> 00:13:06,399
or

373
00:13:10,470 --> 00:13:08,320
drop them in the comments below and they

374
00:13:11,509 --> 00:13:10,480
are patiently doing their dances they

375
00:13:13,269 --> 00:13:11,519
try to

376
00:13:16,069 --> 00:13:13,279
make sure that they are connected to the

377
00:13:18,069 --> 00:13:16,079
spacecraft uh dan shields asks will

378
00:13:21,190 --> 00:13:18,079
there be seismic instruments in the

379
00:13:23,350 --> 00:13:21,200
upcoming venus missions upcoming venus

380
00:13:25,269 --> 00:13:23,360
mission so at this point the the venus

381
00:13:27,509 --> 00:13:25,279
missions that have been selected none of

382
00:13:29,509 --> 00:13:27,519
them are going to the surface

383
00:13:32,069 --> 00:13:29,519
so there wouldn't be any seismic

384
00:13:35,509 --> 00:13:32,079
instruments on those um there have been

385
00:13:38,310 --> 00:13:35,519
proposals for uh possible ways of doing

386
00:13:39,910 --> 00:13:38,320
seismology on venus from orbit

387
00:13:42,310 --> 00:13:39,920
but it would be very different than what

388
00:13:43,990 --> 00:13:42,320

we're doing on insight um so if there is

389
00:13:45,030 --> 00:13:44,000
possibility in the future but in the

390
00:13:47,110 --> 00:13:45,040
currently

391
00:13:49,430 --> 00:13:47,120
selected missions uh there's no plan for

392
00:13:51,750 --> 00:13:49,440
seismology and you know someone was just

393
00:13:53,110 --> 00:13:51,760
asking again what what is this what are

394
00:13:55,110 --> 00:13:53,120
these little bracelets that you're

395
00:13:56,550 --> 00:13:55,120
wearing sure so

396
00:13:59,030 --> 00:13:56,560
uh we have a lot of sensitive

397
00:14:00,230 --> 00:13:59,040
electronics in our test bed area and

398
00:14:01,350 --> 00:14:00,240
they are sensitive to things like

399
00:14:03,670 --> 00:14:01,360
temperature and the other thing is

400
00:14:05,590 --> 00:14:03,680
electrostatic discharge esd so if you

401
00:14:07,350 --> 00:14:05,600
ever touch a doorknob a metal doorknob

402
00:14:08,629 --> 00:14:07,360
and get a little static shock that's

403
00:14:09,910 --> 00:14:08,639
what we're trying to prevent here we

404
00:14:11,590 --> 00:14:09,920
don't want any of those shocks to go

405
00:14:14,310 --> 00:14:11,600
into our electronics and cause any

406
00:14:16,470 --> 00:14:14,320
damage what these wrist straps do is

407
00:14:18,870 --> 00:14:16,480
they ground ourselves

408
00:14:20,629 --> 00:14:18,880
through the spacecraft to our facility

409
00:14:22,470 --> 00:14:20,639
ground so they make sure that if we have

410
00:14:24,150 --> 00:14:22,480
any charge it passes through safely and

411
00:14:26,150 --> 00:14:24,160
doesn't actually affect our electronics

412
00:14:27,670 --> 00:14:26,160
and we can't cause any damage we wear

413
00:14:29,430 --> 00:14:27,680

these when we are close to the

414
00:14:31,990 --> 00:14:29,440
electronics if you're a certain distance

415
00:14:33,670 --> 00:14:32,000
away then you don't need to wear one

416
00:14:36,069 --> 00:14:33,680
great and then we have a couple science

417
00:14:38,470 --> 00:14:36,079
questions coming in now derek ward asked

418
00:14:40,069 --> 00:14:38,480
what is the core made of and does the

419
00:14:43,110 --> 00:14:40,079
core have a

420
00:14:44,550 --> 00:14:43,120
solid core or is it all liquid

421
00:14:45,990 --> 00:14:44,560
that's a really good question and the

422
00:14:48,790 --> 00:14:46,000
short answer is we don't know all of

423
00:14:53,430 --> 00:14:48,800
those answers yet but what i will say

424
00:14:54,949 --> 00:14:53,440
is that the core is metallic its main

425
00:14:56,470 --> 00:14:54,959
main constituents are like the earth

426
00:14:58,230 --> 00:14:56,480
iron and nickel

427
00:15:00,389 --> 00:14:58,240
but its density is low enough that it

428
00:15:01,910 --> 00:15:00,399
has other things in it we don't know

429
00:15:04,069 --> 00:15:01,920
exactly what all of the other things are

430
00:15:05,829 --> 00:15:04,079
a lot of it is probably sulfur

431
00:15:07,750 --> 00:15:05,839
but there are other things carbon

432
00:15:09,110 --> 00:15:07,760
hydrogen other lighter elements that

433
00:15:10,790 --> 00:15:09,120
could be in there to make it be less

434
00:15:12,629 --> 00:15:10,800
dense and we're still trying to work out

435
00:15:15,509 --> 00:15:12,639
what all of those could be in terms of

436
00:15:17,430 --> 00:15:15,519
whether it's liquid or solid we can say

437
00:15:20,230 --> 00:15:17,440
with a high level of certainty that at

438
00:15:22,310 --> 00:15:20,240

the top of the core it's liquid uh we

439
00:15:24,310 --> 00:15:22,320
know that for sure um

440
00:15:26,870 --> 00:15:24,320
because the seismic energy we see

441
00:15:28,870 --> 00:15:26,880
reflects very strongly and also the

442
00:15:30,550 --> 00:15:28,880
radio science tells us that the motions

443
00:15:31,990 --> 00:15:30,560
of the planet are consistent with a

444
00:15:34,150 --> 00:15:32,000
liquid core

445
00:15:36,629 --> 00:15:34,160
at the the where the core

446
00:15:39,189 --> 00:15:36,639
and the rocky mantle come together

447
00:15:41,430 --> 00:15:39,199
we can't say for certain whether it has

448
00:15:42,949 --> 00:15:41,440
a solid inner core like the earth does

449
00:15:45,189 --> 00:15:42,959
we don't have any evidence to say one

450
00:15:46,470 --> 00:15:45,199
way or the other but i will say

451
00:15:48,230 --> 00:15:46,480
under the pressure and temperature

452
00:15:50,069 --> 00:15:48,240
conditions of mars

453
00:15:51,749 --> 00:15:50,079
it's likely that it's all liquid but we

454
00:15:53,749 --> 00:15:51,759
don't know that for sure

455
00:15:56,230 --> 00:15:53,759
more answers to come and then war hero

456
00:15:58,790 --> 00:15:56,240
asks how long was the mission designed

457
00:16:01,269 --> 00:15:58,800
to last and did the mission meet

458
00:16:03,829 --> 00:16:01,279
everyone's expectations when it comes to

459
00:16:05,990 --> 00:16:03,839
the science that came from it absolutely

460
00:16:07,509 --> 00:16:06,000
so our prime mission was schedule was

461
00:16:10,069 --> 00:16:07,519
scheduled to last

462
00:16:13,350 --> 00:16:10,079
about one mars year two earth years

463
00:16:15,189 --> 00:16:13,360

approximately um and we uh designed the

464
00:16:16,470 --> 00:16:15,199
solar panels such that we wouldn't be

465
00:16:18,710 --> 00:16:16,480
sure to have enough energy to get

466
00:16:19,990 --> 00:16:18,720
through that and we did we had plenty of

467
00:16:22,150 --> 00:16:20,000
energy to get through the prime mission

468
00:16:23,910 --> 00:16:22,160
in fact we got another extended mission

469
00:16:25,269 --> 00:16:23,920
that we're in right now that extended it

470
00:16:27,350 --> 00:16:25,279
another two years

471
00:16:30,150 --> 00:16:27,360
um uh we recorded

472
00:16:32,150 --> 00:16:30,160
a whole lot of events we've answered all

473
00:16:34,069 --> 00:16:32,160
of our science goals uh and so we

474
00:16:35,910 --> 00:16:34,079
actually got to looking at the interior

475
00:16:37,749 --> 00:16:35,920
of mars and we're actually extremely

476
00:16:39,269 --> 00:16:37,759
happy with the amount of science we've

477
00:16:41,829 --> 00:16:39,279
been able to achieve and there's still

478
00:16:43,430 --> 00:16:41,839
more happening uh i

479
00:16:45,829 --> 00:16:43,440
didn't mention it but we actually had

480
00:16:48,790 --> 00:16:45,839
the biggest event of the mission just

481
00:16:51,910 --> 00:16:48,800
about a month and a half ago um and uh

482
00:16:53,670 --> 00:16:51,920
and there are so many studies that are

483
00:16:55,110 --> 00:16:53,680
underway looking at all of the new data

484
00:16:56,949 --> 00:16:55,120
we can get with such a big event and

485
00:16:59,509 --> 00:16:56,959
when i say big event it was magnitude

486
00:17:01,509 --> 00:16:59,519
4.7 which on earth isn't that big but on

487
00:17:02,550 --> 00:17:01,519
mars was far bigger than anything else

488
00:17:03,829 --> 00:17:02,560

we'd seen

489
00:17:05,510 --> 00:17:03,839
and i just want you to know that you

490
00:17:08,710 --> 00:17:05,520
have a fan watching right now your

491
00:17:14,789 --> 00:17:11,990
so you're doing great here and uh

492
00:17:18,549 --> 00:17:14,799
i'd also like to know uh

493
00:17:22,069 --> 00:17:18,559
why has the seismometer gone on longer

494
00:17:23,909 --> 00:17:22,079
than previously planned um

495
00:17:27,029 --> 00:17:23,919
more phrasing i think is they want to

496
00:17:28,710 --> 00:17:27,039
know is could using this seismometer

497
00:17:31,510 --> 00:17:28,720
cause it to accidentally shut down

498
00:17:33,510 --> 00:17:31,520
unexpectedly by continuing to use it so

499
00:17:36,390 --> 00:17:33,520
um i will say

500
00:17:39,430 --> 00:17:36,400
we had a time period this is very

501
00:17:41,190 --> 00:17:39,440
interesting stuff happened uh back

502
00:17:44,390 --> 00:17:41,200
about uh

503
00:17:46,070 --> 00:17:44,400
late last summer in 2021 we were

504
00:17:48,070 --> 00:17:46,080
entering the time of the mars season

505
00:17:50,230 --> 00:17:48,080
called aphelion when it's farthest from

506
00:17:51,830 --> 00:17:50,240
the sun and at that point

507
00:17:53,669 --> 00:17:51,840
we're farthest from the sun so we got

508
00:17:55,990 --> 00:17:53,679
the lowest amount of solar energy and we

509
00:17:57,430 --> 00:17:56,000
were at our coldest temperatures and we

510
00:17:58,789 --> 00:17:57,440
were very concerned that we weren't

511
00:18:00,470 --> 00:17:58,799
going to be able to continue operating

512
00:18:03,029 --> 00:18:00,480
instruments through that time

513
00:18:05,510 --> 00:18:03,039

the engineers including here in the test

514
00:18:07,750 --> 00:18:05,520
bed and mult multiple places came up

515
00:18:09,350 --> 00:18:07,760
with lots of great plans uh to try to

516
00:18:12,710 --> 00:18:09,360
get a little more energy out and they

517
00:18:15,590 --> 00:18:12,720
dumped actual rocks on top of the deck

518
00:18:16,710 --> 00:18:15,600
that then blew across the solar panels

519
00:18:17,990 --> 00:18:16,720
and cleaned them off a little bit and

520
00:18:19,270 --> 00:18:18,000
kept us going for longer than we

521
00:18:21,029 --> 00:18:19,280
expected

522
00:18:23,029 --> 00:18:21,039
and that's

523
00:18:24,789 --> 00:18:23,039
an amazing thing and i have all sorts of

524
00:18:26,950 --> 00:18:24,799
compliments for the engineers for for

525
00:18:29,830 --> 00:18:26,960
for making that work

526
00:18:31,510 --> 00:18:29,840
but right now we are not no longer

527
00:18:33,990 --> 00:18:31,520
running the seismometer continuously

528
00:18:36,789 --> 00:18:34,000
we're running it about half of the time

529
00:18:39,350 --> 00:18:36,799
um we are carefully monitoring energy so

530
00:18:42,390 --> 00:18:39,360
it's not at this point going to make the

531
00:18:44,470 --> 00:18:42,400
the spacecraft stop operating

532
00:18:46,870 --> 00:18:44,480
but at some point we're going to get to

533
00:18:49,669 --> 00:18:46,880
a point where we may not be able

534
00:18:51,510 --> 00:18:49,679
to keep doing that but the engineers are

535
00:18:54,150 --> 00:18:51,520
keeping close eye on all of that

536
00:18:56,150 --> 00:18:54,160
yeah yeah thanks to prenatal there's a

537
00:18:58,390 --> 00:18:56,160
large operations team that that mark was

538
00:18:59,750 --> 00:18:58,400

mentioning that every day models energy

539
00:19:01,510 --> 00:18:59,760
looks at the data that's coming back

540
00:19:03,350 --> 00:19:01,520
plans how to use the instruments so that

541
00:19:06,150 --> 00:19:03,360
we have enough power so there's a huge

542
00:19:08,710 --> 00:19:06,160
team behind all the success for insight

543
00:19:10,470 --> 00:19:08,720
absolutely and we were getting some

544
00:19:12,789 --> 00:19:10,480
questions kind of just about the room in

545
00:19:15,270 --> 00:19:12,799
general so this has been used like

546
00:19:16,789 --> 00:19:15,280
historically not just for insight there

547
00:19:19,029 --> 00:19:16,799
have been many other missions and kind

548
00:19:20,630 --> 00:19:19,039
of what you see behind there is from a

549
00:19:22,310 --> 00:19:20,640
previous rover mission and there's all

550
00:19:24,789 --> 00:19:22,320
these uh different parts here could you

551
00:19:26,950 --> 00:19:24,799
kind of get into that too sure so one of

552
00:19:28,710 --> 00:19:26,960
the first missions tested here are the

553
00:19:30,390 --> 00:19:28,720
spirit and opportunity rovers so

554
00:19:32,710 --> 00:19:30,400
actually at that time there was a whole

555
00:19:34,630 --> 00:19:32,720
different surface in here

556
00:19:37,430 --> 00:19:34,640
but this building was built to test

557
00:19:39,510 --> 00:19:37,440
those two rovers after they had left

558
00:19:41,270 --> 00:19:39,520
curiosity for some aspects were tested

559
00:19:43,990 --> 00:19:41,280
in here their test bed was here just

560
00:19:45,669 --> 00:19:44,000
recently perseverance landed on mars and

561
00:19:48,390 --> 00:19:45,679
so they're tested they're our neighbor

562
00:19:50,390 --> 00:19:48,400
so we play together in the sandbox area

563
00:19:52,870 --> 00:19:50,400

going forward new missions will use this

564
00:19:55,110 --> 00:19:52,880
building so this was created as a test

565
00:19:57,190 --> 00:19:55,120
environment and as a universal test

566
00:19:58,630 --> 00:19:57,200
environment so we can reshape it every

567
00:20:00,070 --> 00:19:58,640
time we have a new mission that needs

568
00:20:01,990 --> 00:20:00,080
space one of the things you were

569
00:20:04,789 --> 00:20:02,000
mentioning behind me the black and white

570
00:20:06,549 --> 00:20:04,799
dots are a cal target so for some of our

571
00:20:07,909 --> 00:20:06,559
rover missions that were in here they

572
00:20:09,990 --> 00:20:07,919
were testing some of their cameras and

573
00:20:12,310 --> 00:20:10,000
doing some calibration they used that

574
00:20:14,549 --> 00:20:12,320
target to test out their cameras and

575
00:20:16,470 --> 00:20:14,559
you've also mentioned too these other

576
00:20:17,909 --> 00:20:16,480
cameras around here what are the four

577
00:20:20,470 --> 00:20:17,919
cameras

578
00:20:22,470 --> 00:20:20,480
all around us are they for insight yeah

579
00:20:24,390 --> 00:20:22,480
so we have these four and they look

580
00:20:26,470 --> 00:20:24,400
little black and silver cameras going

581
00:20:28,870 --> 00:20:26,480
all around the insight test bed those

582
00:20:30,549 --> 00:20:28,880
are called vicon motion capture cameras

583
00:20:32,390 --> 00:20:30,559
so they're commonly used in hollywood

584
00:20:34,549 --> 00:20:32,400
and video game design

585
00:20:36,470 --> 00:20:34,559
and they do precision motion tracking

586
00:20:38,630 --> 00:20:36,480
what we use them for is after we

587
00:20:41,750 --> 00:20:38,640
practice each deployment we actually put

588
00:20:44,630 --> 00:20:41,760

a tracking dot from these cameras on the

589
00:20:46,630 --> 00:20:44,640
sites or the hp3 or the wts to see where

590
00:20:48,390 --> 00:20:46,640
we placed it and did we hit our target

591
00:20:50,549 --> 00:20:48,400
we wanted to practice our accuracy and

592
00:20:52,070 --> 00:20:50,559
precision and so using those cameras we

593
00:20:53,830 --> 00:20:52,080
were able to tell how close we got to

594
00:20:54,789 --> 00:20:53,840
our target spot and make tweaks as

595
00:20:56,070 --> 00:20:54,799
needed

596
00:20:58,070 --> 00:20:56,080
great and

597
00:21:00,789 --> 00:20:58,080
if anyone's watching they

598
00:21:02,470 --> 00:21:00,799
have a great insight on the inside

599
00:21:04,950 --> 00:21:02,480
lander and so you have any questions

600
00:21:07,270 --> 00:21:04,960
you'd like to ask use the ask nasa

601
00:21:09,990 --> 00:21:07,280
or leave your comments in the comment

602
00:21:13,510 --> 00:21:10,000
box below and questions as well so we

603
00:21:16,710 --> 00:21:13,520
have a couple other questions coming in

604
00:21:18,310 --> 00:21:16,720
uh let's see here

605
00:21:20,470 --> 00:21:18,320
um

606
00:21:23,029 --> 00:21:20,480
what oh we have some personal questions

607
00:21:25,029 --> 00:21:23,039
coming in what inspired both of you in

608
00:21:26,710 --> 00:21:25,039
your careers and what led you

609
00:21:29,590 --> 00:21:26,720
to nasa

610
00:21:32,390 --> 00:21:29,600
and sure so a couple things for me but

611
00:21:33,909 --> 00:21:32,400
one my cousin is an astrophysicist uh

612
00:21:36,149 --> 00:21:33,919
and so when i was young he would talk

613
00:21:38,149 --> 00:21:36,159

about the stars talk about space show me

614
00:21:39,669 --> 00:21:38,159
things through a telescope and when i

615
00:21:41,110 --> 00:21:39,679
would see those things he would study

616
00:21:42,470 --> 00:21:41,120
them behind the telescope and my first

617
00:21:44,470 --> 00:21:42,480
thought was why don't we go there and

618
00:21:46,870 --> 00:21:44,480
look at it and then that really sparked

619
00:21:48,789 --> 00:21:46,880
my interest in space exploration and

620
00:21:51,590 --> 00:21:48,799
since then i just wanted to be part of

621
00:21:53,270 --> 00:21:51,600
an organization which nasa is that helps

622
00:21:56,070 --> 00:21:53,280
go out into space and create new

623
00:21:58,310 --> 00:21:56,080
discoveries what about you mark yeah

624
00:22:01,669 --> 00:21:58,320
i'd say uh i got involved in this

625
00:22:03,350 --> 00:22:01,679
through a series of happy accidents um i

626
00:22:05,909 --> 00:22:03,360
don't think at any point in my life i

627
00:22:08,310 --> 00:22:05,919
planned on working for nasa it was never

628
00:22:10,630 --> 00:22:08,320
uh never the plan i

629
00:22:12,549 --> 00:22:10,640
ended up in college becoming a geology

630
00:22:14,630 --> 00:22:12,559
major because there was a class that let

631
00:22:17,430 --> 00:22:14,640
me go hiking in montana

632
00:22:19,510 --> 00:22:17,440
uh and and then i took more classes i

633
00:22:21,830 --> 00:22:19,520
was good at math so i started studying

634
00:22:23,029 --> 00:22:21,840
seismology which is geology plus math

635
00:22:23,909 --> 00:22:23,039
more or less

636
00:22:28,149 --> 00:22:23,919
um

637
00:22:29,510 --> 00:22:28,159
but i for uh grad school i focused on

638
00:22:30,950 --> 00:22:29,520

the earth

639
00:22:33,270 --> 00:22:30,960
but uh

640
00:22:37,350 --> 00:22:33,280
in order to stay in berkeley where i did

641
00:22:38,789 --> 00:22:37,360
my studies i got a project that involved

642
00:22:40,950 --> 00:22:38,799
thinking about what seismology would

643
00:22:43,590 --> 00:22:40,960
look like on europa which is a moon of

644
00:22:45,750 --> 00:22:43,600
jupiter um it was just somebody had a

645
00:22:47,909 --> 00:22:45,760
project i was like that sounds like fun

646
00:22:50,390 --> 00:22:47,919
and uh since then i've just been

647
00:22:53,750 --> 00:22:50,400
following opportunities like that um and

648
00:22:55,750 --> 00:22:53,760
some where along the line um uh the the

649
00:22:57,590 --> 00:22:55,760
lead of the mission uh principal

650
00:22:59,590 --> 00:22:57,600
investigator bruce banner uh talked to

651
00:23:01,430 --> 00:22:59,600
me and said we're thinking about doing

652
00:23:04,390 --> 00:23:01,440
seismology on mars would you like to be

653
00:23:07,590 --> 00:23:04,400
involved and i said yes with a big smile

654
00:23:10,310 --> 00:23:07,600
on my face and um now

655
00:23:12,149 --> 00:23:10,320
14 15 years later i'm still working on

656
00:23:14,149 --> 00:23:12,159
that project

657
00:23:15,590 --> 00:23:14,159
that's great and we have some questions

658
00:23:17,430 --> 00:23:15,600
coming in for you mark which we'll get

659
00:23:19,990 --> 00:23:17,440
to in a second but a lot of people are

660
00:23:23,990 --> 00:23:20,000
curious about the panels the solar

661
00:23:26,070 --> 00:23:24,000
panels can they be cleaned off on mars

662
00:23:28,710 --> 00:23:26,080
so insight itself does not have the

663
00:23:30,230 --> 00:23:28,720

capability of cleaning its solar panels

664
00:23:32,230 --> 00:23:30,240
if they do get cleaned it would be

665
00:23:34,230 --> 00:23:32,240
hopefully through one of the wind

666
00:23:36,230 --> 00:23:34,240
cleaning events that marx mentioned one

667
00:23:37,909 --> 00:23:36,240
of the questions that does get asked is

668
00:23:39,909 --> 00:23:37,919
why don't we have a way to clean our

669
00:23:42,310 --> 00:23:39,919
solar panels so

670
00:23:44,230 --> 00:23:42,320
the goal of insight is to collect the

671
00:23:45,510 --> 00:23:44,240
science data and meet answer the science

672
00:23:47,830 --> 00:23:45,520
questions that mark's discussed which

673
00:23:49,909 --> 00:23:47,840
we've done extremely well

674
00:23:51,990 --> 00:23:49,919
anytime you want to add more engineering

675
00:23:54,390 --> 00:23:52,000
complexities such as a way to clean

676
00:23:56,390 --> 00:23:54,400
solar panels we've incurred now we'll

677
00:23:57,990 --> 00:23:56,400
have new actuators new mechanisms we'll

678
00:23:59,590 --> 00:23:58,000
have to have a way to test it we'll have

679
00:24:00,950 --> 00:23:59,600
to have a way to make sure that it works

680
00:24:03,909 --> 00:24:00,960
we have to have a way to ensure that

681
00:24:05,909 --> 00:24:03,919
those items can't actually harm any of

682
00:24:08,070 --> 00:24:05,919
our science collection so our first

683
00:24:10,070 --> 00:24:08,080
priority is to ensure that anything we

684
00:24:11,430 --> 00:24:10,080
do we'll answer the science questions

685
00:24:13,190 --> 00:24:11,440
and make sure we bring our science data

686
00:24:14,630 --> 00:24:13,200
back and as mark mentioned the solar

687
00:24:16,070 --> 00:24:14,640
panels were sized so that they could

688
00:24:17,510 --> 00:24:16,080

meet the prime mission without requiring

689
00:24:19,269 --> 00:24:17,520
any cleaning

690
00:24:21,110 --> 00:24:19,279
and we're going to head back to the

691
00:24:23,350 --> 00:24:21,120
science questions we'll do our little

692
00:24:26,390 --> 00:24:23,360
dance with

693
00:24:30,470 --> 00:24:28,070
at this point

694
00:24:32,710 --> 00:24:30,480
it's fun to see so a few science

695
00:24:39,190 --> 00:24:32,720
questions coming in here has the lander

696
00:24:43,510 --> 00:24:41,110
on the scale of what people would think

697
00:24:45,510 --> 00:24:43,520
about as moving the answer is no

698
00:24:47,750 --> 00:24:45,520
it's been very stable

699
00:24:49,430 --> 00:24:47,760
people hear about big wind storms on

700
00:24:51,830 --> 00:24:49,440
mars and they do have very high

701
00:24:54,149 --> 00:24:51,840
velocities but the atmosphere is very

702
00:24:57,350 --> 00:24:54,159
very thin on mars

703
00:24:59,990 --> 00:24:57,360
it's about half a percent as dense as

704
00:25:01,669 --> 00:25:00,000
our atmosphere and so even when you have

705
00:25:03,750 --> 00:25:01,679
very strong winds it actually doesn't

706
00:25:06,390 --> 00:25:03,760
have that much force if you've seen the

707
00:25:07,990 --> 00:25:06,400
martian the beginning scene

708
00:25:10,230 --> 00:25:08,000
wouldn't happen on mars you wouldn't

709
00:25:12,630 --> 00:25:10,240
have enough energy to knock antennas

710
00:25:14,390 --> 00:25:12,640
over and do all of those things so

711
00:25:17,990 --> 00:25:14,400
hasn't moved

712
00:25:19,190 --> 00:25:18,000
on a large scale but um it does move on

713
00:25:21,430 --> 00:25:19,200

the very small scales that the

714
00:25:23,909 --> 00:25:21,440
seismometer can measure um as a matter

715
00:25:25,990 --> 00:25:23,919
of fact before we put ourselves down on

716
00:25:27,269 --> 00:25:26,000
the surface we were able to turn on one

717
00:25:29,590 --> 00:25:27,279
of the seismometers while it was still

718
00:25:31,830 --> 00:25:29,600
on the deck and we measured how much the

719
00:25:34,230 --> 00:25:31,840
lander moved in the wind and it actually

720
00:25:36,149 --> 00:25:34,240
moved in a measurable way back and forth

721
00:25:38,950 --> 00:25:36,159
very similar to how the viking landers

722
00:25:40,549 --> 00:25:38,960
moved which had seismometers on them but

723
00:25:42,070 --> 00:25:40,559
never got deployed down to the surface

724
00:25:44,710 --> 00:25:42,080
so they never saw mars quakes they just

725
00:25:46,230 --> 00:25:44,720
saw how the lander moved so

726
00:25:47,750 --> 00:25:46,240
that's all about how sensitive the

727
00:25:49,830 --> 00:25:47,760
seismometer is it can measure motions

728
00:25:52,870 --> 00:25:49,840
that are about the size of a hydrogen

729
00:25:55,909 --> 00:25:52,880
atom so very small motions can be seen

730
00:25:58,149 --> 00:25:55,919
but not to the point that you'd actually

731
00:26:00,149 --> 00:25:58,159
physically see the lander moving

732
00:26:02,549 --> 00:26:00,159
yeah that's quite the visual though to

733
00:26:04,549 --> 00:26:02,559
picture an atom moving and the next

734
00:26:06,789 --> 00:26:04,559
question is about temperature how hot

735
00:26:09,430 --> 00:26:06,799
are the temperatures during the day on

736
00:26:12,310 --> 00:26:09,440
mars and how cold does it get at night

737
00:26:14,310 --> 00:26:12,320
i i'm so um

738
00:26:17,190 --> 00:26:14,320

i don't want to answer that incorrectly

739
00:26:20,549 --> 00:26:17,200
okay so i it does get very cold i will

740
00:26:23,190 --> 00:26:20,559
say that we uh on in the warm

741
00:26:25,190 --> 00:26:23,200
electronics box on the inside of of

742
00:26:26,789 --> 00:26:25,200
insight which is inside there where you

743
00:26:27,990 --> 00:26:26,799
can't see it

744
00:26:29,669 --> 00:26:28,000
it's

745
00:26:31,830 --> 00:26:29,679
over time we've let it get colder than

746
00:26:34,390 --> 00:26:31,840
we initially designed for but now it

747
00:26:38,630 --> 00:26:34,400
gets down to temperatures of

748
00:26:40,549 --> 00:26:38,640
minus 35 celsius minus 38 celsius

749
00:26:42,390 --> 00:26:40,559
the surface gets much colder than that

750
00:26:43,909 --> 00:26:42,400
but i don't know the exact number so i

751
00:26:46,149 --> 00:26:43,919
don't want to say an incorrect number

752
00:26:48,870 --> 00:26:46,159
but it does get it does get quite chilly

753
00:26:50,789 --> 00:26:48,880
and during the day um it still is

754
00:26:53,430 --> 00:26:50,799
generally below zero degrees celsius so

755
00:26:55,990 --> 00:26:53,440
even on the balmiest summer days

756
00:26:58,549 --> 00:26:56,000
it's still very cold on mars no problem

757
00:27:01,190 --> 00:26:58,559
we can get you an answer in celsius and

758
00:27:04,549 --> 00:27:01,200
degrees at a later time but thanks that

759
00:27:07,909 --> 00:27:04,559
was a great question and then a question

760
00:27:08,710 --> 00:27:07,919
for both of you from sin city jim he

761
00:27:10,950 --> 00:27:08,720
says

762
00:27:14,149 --> 00:27:10,960
i know they're just machines but i get

763
00:27:15,590 --> 00:27:14,159

kind of sad when they come to an end

764
00:27:18,149 --> 00:27:15,600
it's almost like the death of a good

765
00:27:19,909 --> 00:27:18,159
friend do either of you feel that way

766
00:27:21,669 --> 00:27:19,919
when you think of a mission coming to an

767
00:27:23,909 --> 00:27:21,679
end i don't know who'd like to go first

768
00:27:25,909 --> 00:27:23,919
uh i absolutely feel that way insight

769
00:27:28,310 --> 00:27:25,919
was the first flight project i got to

770
00:27:32,230 --> 00:27:28,320
work on when i joined jpl i've been on

771
00:27:34,470 --> 00:27:32,240
it now for five and a half years uh

772
00:27:35,990 --> 00:27:34,480
i feel like insight's my friend uh i

773
00:27:38,070 --> 00:27:36,000
feel like every time insight makes a

774
00:27:39,750 --> 00:27:38,080
discovery or something amazing happens

775
00:27:41,750 --> 00:27:39,760
with insight i get excited the whole

776
00:27:44,070 --> 00:27:41,760
team gets excited uh whenever the

777
00:27:45,750 --> 00:27:44,080
mission does end i will be extremely sad

778
00:27:47,269 --> 00:27:45,760
but feel very fortunate and lucky to

779
00:27:48,549 --> 00:27:47,279
have worked on it

780
00:27:50,630 --> 00:27:48,559
yeah

781
00:27:52,230 --> 00:27:50,640
as i said in an answer to an earlier

782
00:27:55,750 --> 00:27:52,240
question i think i've been working on

783
00:27:58,149 --> 00:27:55,760
insight at for around 15 years now

784
00:27:59,750 --> 00:27:58,159
so this is a big part of my life

785
00:28:01,830 --> 00:27:59,760
it's been

786
00:28:03,990 --> 00:28:01,840
obviously something i'll always think

787
00:28:06,230 --> 00:28:04,000
about we had an earlier video where i

788
00:28:09,029 --> 00:28:06,240

showed my arm i don't know if i could do

789
00:28:12,789 --> 00:28:09,039
that here but there you go there's the

790
00:28:14,549 --> 00:28:12,799
the insight logo um so uh i will say

791
00:28:15,990 --> 00:28:14,559
that insights left a permanent mark on

792
00:28:16,710 --> 00:28:16,000
me

793
00:28:18,710 --> 00:28:16,720
and

794
00:28:20,710 --> 00:28:18,720
obviously when it ends it will be very

795
00:28:22,630 --> 00:28:20,720
sad but

796
00:28:24,630 --> 00:28:22,640
all things

797
00:28:25,990 --> 00:28:24,640
must pass as george harrison would say i

798
00:28:27,750 --> 00:28:26,000
guess

799
00:28:33,750 --> 00:28:27,760
i think a nice way to conclude it is

800
00:28:37,430 --> 00:28:35,909
that is a tough question to answer

801
00:28:39,590 --> 00:28:37,440
there's been a lot of

802
00:28:41,110 --> 00:28:39,600
good memories i think for me i spent

803
00:28:43,029 --> 00:28:41,120
most of my time working on insight in

804
00:28:45,750 --> 00:28:43,039
this room and as i mentioned we

805
00:28:47,990 --> 00:28:45,760
practiced all our deployments in here so

806
00:28:50,789 --> 00:28:48,000
i think really every time we got the

807
00:28:52,230 --> 00:28:50,799
seismometer to touch down we got the wts

808
00:28:54,230 --> 00:28:52,240
the wind and thermoshield on top of the

809
00:28:56,630 --> 00:28:54,240
seismometer we got the hp3 down each

810
00:28:58,389 --> 00:28:56,640
time those three events happened i felt

811
00:29:00,789 --> 00:28:58,399
elated it was just amazing that the

812
00:29:03,350 --> 00:29:00,799
things we tested in here so precisely we

813
00:29:04,310 --> 00:29:03,360

were able to do on mars successfully

814
00:29:06,310 --> 00:29:04,320
yeah i

815
00:29:09,430 --> 00:29:06,320
there's a million and so i i have a

816
00:29:12,950 --> 00:29:09,440
heart i i'll say probably the most

817
00:29:15,909 --> 00:29:12,960
overall intense experience so i

818
00:29:18,070 --> 00:29:15,919
started at jpl in 2017 just the year

819
00:29:20,230 --> 00:29:18,080
before we actually landed and then once

820
00:29:22,310 --> 00:29:20,240
we actually landed we

821
00:29:24,389 --> 00:29:22,320
for the next two and a half months while

822
00:29:25,510 --> 00:29:24,399
we were doing the deployment process it

823
00:29:28,070 --> 00:29:25,520
was

824
00:29:29,590 --> 00:29:28,080
all the time in sight we had meetings

825
00:29:31,269 --> 00:29:29,600
constantly and we were just talking

826
00:29:33,510 --> 00:29:31,279
through everything and it was just a

827
00:29:35,350 --> 00:29:33,520
very intense experience um in fact for

828
00:29:36,789 --> 00:29:35,360
the first week we were on mars time and

829
00:29:37,669 --> 00:29:36,799
i had to come in in the middle of the

830
00:29:38,470 --> 00:29:37,679
night

831
00:29:41,430 --> 00:29:38,480
and

832
00:29:43,669 --> 00:29:41,440
that was yeah that's that was like

833
00:29:45,510 --> 00:29:43,679
nothing else i guess

834
00:29:47,990 --> 00:29:45,520
what is mars time for people who might

835
00:29:49,669 --> 00:29:48,000
not know what that is um so basically

836
00:29:51,669 --> 00:29:49,679
the mars day

837
00:29:54,549 --> 00:29:51,679
is a little bit longer than the earth

838
00:29:55,990 --> 00:29:54,559

day um and

839
00:29:58,630 --> 00:29:56,000
when you're working and you're trying to

840
00:30:00,789 --> 00:29:58,640
do things on a quick pace you want to

841
00:30:03,669 --> 00:30:00,799
line up your work schedule to when we

842
00:30:04,470 --> 00:30:03,679
can communicate with the lander um and

843
00:30:06,789 --> 00:30:04,480
so

844
00:30:10,070 --> 00:30:06,799
that timing depends on time of day on

845
00:30:12,549 --> 00:30:10,080
mars not time of day on earth and so for

846
00:30:15,269 --> 00:30:12,559
the first week or so we

847
00:30:17,269 --> 00:30:15,279
timed our working shifts to be matching

848
00:30:19,029 --> 00:30:17,279
up with the uplink and downlink times on

849
00:30:21,029 --> 00:30:19,039
mars and that was shift a little bit

850
00:30:22,710 --> 00:30:21,039
each day about 40 minutes

851
00:30:24,470 --> 00:30:22,720
and it happened to be at that time of

852
00:30:26,549 --> 00:30:24,480
year it was kind of in the middle of the

853
00:30:27,669 --> 00:30:26,559
night so i got to see jpl in the middle

854
00:30:29,190 --> 00:30:27,679
of the night and there are crazy

855
00:30:30,310 --> 00:30:29,200
raccoons on lap in the middle of the

856
00:30:31,750 --> 00:30:30,320
night

857
00:30:33,909 --> 00:30:31,760
i don't think people know about all the

858
00:30:35,269 --> 00:30:33,919
critters that kind of move around here

859
00:30:36,870 --> 00:30:35,279
is there anything

860
00:30:37,909 --> 00:30:36,880
you'd like to say to your fellow team

861
00:30:39,830 --> 00:30:37,919
members

862
00:30:41,590 --> 00:30:39,840
as well um

863
00:30:43,110 --> 00:30:41,600

i just you know i really want to

864
00:30:46,549 --> 00:30:43,120
emphasize that

865
00:30:48,389 --> 00:30:46,559
this is a huge team effort um

866
00:30:50,470 --> 00:30:48,399
there are hundreds of people that have

867
00:30:52,310 --> 00:30:50,480
been involved in this and i cannot list

868
00:30:53,909 --> 00:30:52,320
them all we have

869
00:30:55,669 --> 00:30:53,919
hundreds of people on the science team

870
00:30:57,430 --> 00:30:55,679
that i'm dealing with directly we have

871
00:30:59,669 --> 00:30:57,440
hundreds of people on the operations

872
00:31:01,590 --> 00:30:59,679
team we have all of the people working

873
00:31:03,269 --> 00:31:01,600
here at the test bed and

874
00:31:05,350 --> 00:31:03,279
all of them were essential to make this

875
00:31:07,110 --> 00:31:05,360
happen there's no way we could do this

876
00:31:07,909 --> 00:31:07,120
without everybody working together and

877
00:31:10,710 --> 00:31:07,919
so

878
00:31:12,710 --> 00:31:10,720
everything that happens is

879
00:31:15,029 --> 00:31:12,720
just such a team effort and you know

880
00:31:17,350 --> 00:31:15,039
it's it's hard to imagine how much it

881
00:31:19,190 --> 00:31:17,360
depends on all of these different people

882
00:31:21,350 --> 00:31:19,200
yeah i want to just echo mark's comments

883
00:31:24,149 --> 00:31:21,360
there's a massive team of engineers

884
00:31:26,230 --> 00:31:24,159
scientists and others who made insight

885
00:31:27,509 --> 00:31:26,240
successful and i think the greatest joy

886
00:31:29,750 --> 00:31:27,519
we all have is we all got to work

887
00:31:32,470 --> 00:31:29,760
together on this this amazing mission

888
00:31:34,549 --> 00:31:32,480

and got to do something novel uh with

889
00:31:36,789 --> 00:31:34,559
the work we did yeah and it was nice to

890
00:31:38,789 --> 00:31:36,799
see you mentioned before

891
00:31:40,710 --> 00:31:38,799
visions come to life with the

892
00:31:42,549 --> 00:31:40,720
instruments that you put out together

893
00:31:44,070 --> 00:31:42,559
well that is all the time we have today

894
00:31:46,230 --> 00:31:44,080
thank you for your questions and thanks

895
00:31:47,509 --> 00:31:46,240
to prenate and mark for answering them

896
00:31:50,630 --> 00:31:47,519
and if you want to learn more about

897
00:31:54,310 --> 00:31:50,640
insight visit mars.nasa.gov

898
00:31:56,789 --> 00:31:54,320
insight and follow nasa insight at nasa