1
00:00:05,670 --> 00:00:03,750
[Music]

2
00:00:07,269 --> 00:00:05,680
nasa's jet propulsion laboratory

3
00:00:09,910 --> 00:00:07,279
presents

4
00:00:11,990 --> 00:00:09,920
the von carmen lecture a series of talks

5
00:00:15,270 --> 00:00:12,000
by scientists and engineers who are

6
00:00:23,029 --> 00:00:15,280
exploring our planet our solar system

7
00:00:28,870 --> 00:00:25,509
hello and welcome to another edition of

8
00:00:30,550 --> 00:00:28,880
the 2022 von carmen talks i am nikki

9
00:00:33,030 --> 00:00:30,560
weirich from jpl's office of

10
00:00:35,430 --> 00:00:33,040
communications and education and i will

11
00:00:37,830 --> 00:00:35,440
be your host for our topic this evening

12
00:00:39,270 --> 00:00:37,840
spacecraft assembly test and launch

13
00:00:41,030 --> 00:00:39,280

operations

14
00:00:43,590 --> 00:00:41,040
getting spacecraft ready for launch

15
00:00:46,470 --> 00:00:43,600
requires an extensive team tons of

16
00:00:48,310 --> 00:00:46,480
flexibility and some serious dedication

17
00:00:50,790 --> 00:00:48,320
tonight we will look at how the assembly

18
00:00:53,750 --> 00:00:50,800
test and launch operations or atlo team

19
00:00:57,750 --> 00:00:53,760
come together to assemble it bake it

20
00:01:00,069 --> 00:00:57,760
shake it get it to the pad and launch it

21
00:01:02,549 --> 00:01:00,079
joining us as co-host this evening is

22
00:01:06,310 --> 00:01:02,559
brian white from jpl's office of

23
00:01:08,469 --> 00:01:06,320
communications and education hiya brian

24
00:01:10,149 --> 00:01:08,479
hiya nikki thanks for having me hiya

25
00:01:12,230 --> 00:01:10,159
folks uh we just want to remind you that

26
00:01:14,310 --> 00:01:12,240
this is your space program and we want

27
00:01:16,070 --> 00:01:14,320
you to be involved in this conversation

28
00:01:17,749 --> 00:01:16,080
so whatever you're watching it on there

29
00:01:19,270 --> 00:01:17,759
should be a chat box go ahead and ask

30
00:01:22,469 --> 00:01:19,280
your questions in there and we'll get as

31
00:01:24,230 --> 00:01:22,479
many chats as we possibly can in tonight

32
00:01:26,149 --> 00:01:24,240
if you don't see the chat box go ahead

33
00:01:27,830 --> 00:01:26,159
and refresh your page and it should be

34
00:01:29,749 --> 00:01:27,840
right there looking forward to this talk

35
00:01:31,350 --> 00:01:29,759
about atlo

36
00:01:33,749 --> 00:01:31,360
awesome brian thank you so much for

37
00:01:35,990 --> 00:01:33,759
being here and to all of you watching as

38
00:01:38,230 --> 00:01:36,000

always if we do run into any technical

39
00:01:39,910 --> 00:01:38,240
difficulties or small failures tonight

40
00:01:41,749 --> 00:01:39,920
we ask for your patience and please

41
00:01:43,350 --> 00:01:41,759
stick with us we'll get them sorted out

42
00:01:45,109 --> 00:01:43,360
as soon as we can

43
00:01:47,429 --> 00:01:45,119
our first speaker this evening joining

44
00:01:50,630 --> 00:01:47,439
us is michelle kolizzi a mechanical

45
00:01:52,630 --> 00:01:50,640
engineer at jpl since 2015. she

46
00:01:55,030 --> 00:01:52,640
currently serves as group supervisor for

47
00:01:56,870 --> 00:01:55,040
the mechanisms and mobility group in the

48
00:01:58,950 --> 00:01:56,880
spacecraft mechanical engineering

49
00:02:01,270 --> 00:01:58,960
section previously she was the

50
00:02:03,830 --> 00:02:01,280
mechanical lead for the psyche atlo team

51
00:02:06,950 --> 00:02:03,840
and was a member of the mars 2020 atla

52
00:02:08,389 --> 00:02:06,960
team and prior to joining jpl michelle

53
00:02:10,309 --> 00:02:08,399
worked at applied instrument

54
00:02:13,830 --> 00:02:10,319
technologies where she served as a

55
00:02:15,910 --> 00:02:13,840
project and r d engineer she was also a

56
00:02:18,550 --> 00:02:15,920
part-time instructor at california state

57
00:02:20,470 --> 00:02:18,560
polytechnic university pomona where she

58
00:02:22,390 --> 00:02:20,480
also earned her bachelor of science and

59
00:02:24,470 --> 00:02:22,400
her master of science in mechanical

60
00:02:26,949 --> 00:02:24,480
engineering hi michelle thanks so much

61
00:02:29,030 --> 00:02:26,959
for joining us this evening

62
00:02:30,390 --> 00:02:29,040
thank you nikki glad to be here tonight

63
00:02:32,550 --> 00:02:30,400

with you guys

64
00:02:35,110 --> 00:02:32,560
oh we are so glad you're here so tell us

65
00:02:37,430 --> 00:02:35,120
what is atlo

66
00:02:39,910 --> 00:02:37,440
yeah so like you said it's assembly test

67
00:02:41,990 --> 00:02:39,920
and launch operations it's where all of

68
00:02:43,750 --> 00:02:42,000
the piece parts and components of a

69
00:02:46,470 --> 00:02:43,760
spacecraft actually come together to get

70
00:02:48,470 --> 00:02:46,480
assembled to create the spacecraft

71
00:02:49,910 --> 00:02:48,480
it consists of a team of various

72
00:02:51,589 --> 00:02:49,920
disciplines from all fields of

73
00:02:53,830 --> 00:02:51,599
engineering we've got mechanical

74
00:02:56,150 --> 00:02:53,840
engineers mechanical technicians

75
00:02:59,589 --> 00:02:56,160
electrical engineers system engineers

76
00:03:01,670 --> 00:02:59,599
propulsion engineers thermal engineers

77
00:03:04,390 --> 00:03:01,680
hardware quality assurance

78
00:03:06,710 --> 00:03:04,400
system safety occupational safety

79
00:03:09,589 --> 00:03:06,720
i mean you name it we've we've got a

80
00:03:11,670 --> 00:03:09,599
wide variety of people that all serve a

81
00:03:13,190 --> 00:03:11,680
very unique and important role as part

82
00:03:15,030 --> 00:03:13,200
of the team

83
00:03:17,030 --> 00:03:15,040
so not only do we just assemble the

84
00:03:19,190 --> 00:03:17,040
spacecraft but we also test the

85
00:03:21,830 --> 00:03:19,200
spacecraft both functionally as well as

86
00:03:24,309 --> 00:03:21,840
environments uh we're responsible for

87
00:03:26,869 --> 00:03:24,319
transporting the spacecraft if we can

88
00:03:29,670 --> 00:03:26,879

actually show uh photo seven all of the

89
00:03:31,350 --> 00:03:29,680
ground transports

90
00:03:32,630 --> 00:03:31,360
um that we do to move the spacecraft

91
00:03:34,149 --> 00:03:32,640
from one building to the next for

92
00:03:37,350 --> 00:03:34,159
different integration operations

93
00:03:39,110 --> 00:03:37,360
different testing operations we we are

94
00:03:40,149 --> 00:03:39,120
responsible for the hardware

95
00:03:42,309 --> 00:03:40,159
safety

96
00:03:43,910 --> 00:03:42,319
um the the movement of it maintaining

97
00:03:45,670 --> 00:03:43,920
the cleanliness of it

98
00:03:50,149 --> 00:03:45,680
and actually executing the test if we

99
00:03:53,190 --> 00:03:51,750
yeah so this is an example of one of the

100
00:03:55,589 --> 00:03:53,200
recent tests that we did in the thermal

101
00:03:57,429 --> 00:03:55,599
chamber it all the disciplines are

102
00:03:58,789 --> 00:03:57,439
involved in these various phases of the

103
00:04:00,390 --> 00:03:58,799
test

104
00:04:02,630 --> 00:04:00,400
the planning the writing of the

105
00:04:04,550 --> 00:04:02,640
instructional procedures

106
00:04:06,550 --> 00:04:04,560
as well as the the physical execution

107
00:04:08,309 --> 00:04:06,560
the integration operations for the final

108
00:04:10,550 --> 00:04:08,319
the piece parts that get installed on

109
00:04:12,949 --> 00:04:10,560
the spacecraft that are critical to

110
00:04:14,869 --> 00:04:12,959
these tests uh we have to to take all of

111
00:04:16,310 --> 00:04:14,879
those considerations into account

112
00:04:19,030 --> 00:04:16,320
especially since most of the members on

113
00:04:21,749 --> 00:04:19,040

the team were not the original designers

114
00:04:24,150 --> 00:04:21,759
of the individual components so it's a

115
00:04:26,710 --> 00:04:24,160
lot of interaction with those engineers

116
00:04:29,270 --> 00:04:26,720
who designed it making sure we take care

117
00:04:31,670 --> 00:04:29,280
and are doing the hardware justice

118
00:04:33,670 --> 00:04:31,680
having all of the safety considerations

119
00:04:36,150 --> 00:04:33,680
because we want this to come together as

120
00:04:39,749 --> 00:04:36,160
as seamlessly as possible to do what

121
00:04:43,189 --> 00:04:41,510
that is great can you tell us a little

122
00:04:46,550 --> 00:04:43,199
bit more like what are the mechanics

123
00:04:51,670 --> 00:04:48,870
yeah um so if we can actually flip to

124
00:04:55,110 --> 00:04:51,680
slide two um

125
00:04:57,350 --> 00:04:55,120
with the mechanics so a lot of us work

126
00:04:59,430 --> 00:04:57,360
primarily in a clean room this is this

127
00:05:01,749 --> 00:04:59,440
is actually a prime example on mars 2020

128
00:05:03,749 --> 00:05:01,759
we were in full bunny suits we have to

129
00:05:05,430 --> 00:05:03,759
maintain that cleanliness in the

130
00:05:07,749 --> 00:05:05,440
facility when we're working directly

131
00:05:09,350 --> 00:05:07,759
with the hardware there's also a number

132
00:05:10,870 --> 00:05:09,360
of folks like our systems engineering

133
00:05:13,189 --> 00:05:10,880
team who do come onto the floor from

134
00:05:15,270 --> 00:05:13,199
time to time but they support us on

135
00:05:16,870 --> 00:05:15,280
console for for a lot of the functional

136
00:05:18,950 --> 00:05:16,880
tests so this was actually a very

137
00:05:20,629 --> 00:05:18,960
interactive test that we did here um

138
00:05:22,870 --> 00:05:20,639

which was was showing the deployment of

139
00:05:24,469 --> 00:05:22,880
the sky crane maneuver by manually

140
00:05:25,990 --> 00:05:24,479
operating a crane

141
00:05:28,070 --> 00:05:26,000
which actually a lot of us are trained

142
00:05:29,830 --> 00:05:28,080
to do in the atlu environment i had

143
00:05:31,270 --> 00:05:29,840
never in a million years thought growing

144
00:05:32,629 --> 00:05:31,280
up that i would be calling a crane

145
00:05:36,390 --> 00:05:32,639
operation

146
00:05:38,870 --> 00:05:36,400
let alone with with spacecraft hardware

147
00:05:42,629 --> 00:05:38,880
and that's something that becomes nearly

148
00:05:44,950 --> 00:05:42,639
a daily activity for us there uh we've

149
00:05:47,270 --> 00:05:44,960
got and it is it is definitely a

150
00:05:49,590 --> 00:05:47,280
production you have to rely and trust

151
00:05:51,110 --> 00:05:49,600
the team that works with you

152
00:05:52,950 --> 00:05:51,120
to be able to execute it because no

153
00:05:55,029 --> 00:05:52,960
single person can do it on their own

154
00:05:57,270 --> 00:05:55,039
everyone plays an absolutely critical

155
00:05:59,990 --> 00:05:57,280
part and we couldn't be successful if we

156
00:06:02,309 --> 00:06:00,000
all didn't give it 100 effort really

157
00:06:05,110 --> 00:06:02,319
show that passion and that care to what

158
00:06:07,270 --> 00:06:05,120
we do and attention to detail both big

159
00:06:08,070 --> 00:06:07,280
and small

160
00:06:09,270 --> 00:06:08,080
so

161
00:06:10,870 --> 00:06:09,280
that's great to hear a little bit about

162
00:06:13,189 --> 00:06:10,880
the mechanics and you mentioned the team

163
00:06:14,950 --> 00:06:13,199

so what does a normal day look like and

164
00:06:17,189 --> 00:06:14,960
who kind of makes up these teams that do

165
00:06:19,909 --> 00:06:17,199
all this work

166
00:06:21,830 --> 00:06:19,919
yeah so a normal day it's an early start

167
00:06:24,070 --> 00:06:21,840
for us we we typically get together

168
00:06:27,270 --> 00:06:24,080
around seven o'clock and we look at a

169
00:06:28,950 --> 00:06:27,280
tactical planning so the leads of of all

170
00:06:30,309 --> 00:06:28,960
the disciplines as well as the at low

171
00:06:32,230 --> 00:06:30,319
lead

172
00:06:34,150 --> 00:06:32,240
we pull up our schedule for it for the

173
00:06:36,629 --> 00:06:34,160
day and it shows all the activities that

174
00:06:39,510 --> 00:06:36,639
we want to accomplish on a daily basis

175
00:06:41,590 --> 00:06:39,520
with even half half shift goals full

176
00:06:43,110 --> 00:06:41,600
shift goals a couple days out and we

177
00:06:44,870 --> 00:06:43,120
look at at

178
00:06:47,990 --> 00:06:44,880
about a seven day

179
00:06:49,670 --> 00:06:48,000
outlook we also meet twice a week and we

180
00:06:51,350 --> 00:06:49,680
we typically do strategic planning where

181
00:06:52,950 --> 00:06:51,360
we look more at big picture we

182
00:06:54,790 --> 00:06:52,960
understand when hardware deliverables

183
00:06:56,629 --> 00:06:54,800
are coming in what the order of

184
00:06:58,870 --> 00:06:56,639
operations are

185
00:07:00,629 --> 00:06:58,880
and then we execute so then after we

186
00:07:03,270 --> 00:07:00,639
have our tactical planning meeting we

187
00:07:05,350 --> 00:07:03,280
then start to to gather in our groups of

188
00:07:07,029 --> 00:07:05,360

our own disciplines so i would lead

189
00:07:09,270 --> 00:07:07,039
mechanical meetings let's say on psyche

190
00:07:10,870 --> 00:07:09,280
as a mechanical mechanical lead and we

191
00:07:12,710 --> 00:07:10,880
then brief the team who would do a lot

192
00:07:14,950 --> 00:07:12,720
of the actual hands-on execution on the

193
00:07:16,710 --> 00:07:14,960
floor what the priorities are what the

194
00:07:18,950 --> 00:07:16,720
nice to haves that day were what the

195
00:07:20,629 --> 00:07:18,960
operations are for the next day how to

196
00:07:23,350 --> 00:07:20,639
start planning if they can get ahead in

197
00:07:25,749 --> 00:07:23,360
areas what areas to take advantage of uh

198
00:07:27,830 --> 00:07:25,759
but but but you have to be very flexible

199
00:07:30,070 --> 00:07:27,840
so really identifying what those

200
00:07:32,070 --> 00:07:30,080
priorities are early on in the day are

201
00:07:34,309 --> 00:07:32,080
very pivotal and then after that we

202
00:07:36,150 --> 00:07:34,319
dismiss and people go and they they get

203
00:07:37,990 --> 00:07:36,160
the hard route on the floor they pull

204
00:07:39,189 --> 00:07:38,000
out their procedures for for the work

205
00:07:40,710 --> 00:07:39,199
that they're going to do whether it's an

206
00:07:43,110 --> 00:07:40,720
integration operation a testing

207
00:07:45,029 --> 00:07:43,120
operation a transport operation and then

208
00:07:46,629 --> 00:07:45,039
they work with with the crew that's on

209
00:07:49,110 --> 00:07:46,639
the floor the technicians the quality

210
00:07:51,350 --> 00:07:49,120
assurance and sometimes system safety to

211
00:07:53,029 --> 00:07:51,360
make sure that those those goals are met

212
00:07:54,869 --> 00:07:53,039
um if there is if there is a problem

213
00:07:56,869 --> 00:07:54,879

that arises on the floor no matter how

214
00:07:59,189 --> 00:07:56,879
large or small they immediately notify

215
00:08:02,070 --> 00:07:59,199
the rest of the team you have to be very

216
00:08:04,469 --> 00:08:02,080
proactive but also very reactive while

217
00:08:06,309 --> 00:08:04,479
while doing this work on the floor so

218
00:08:09,830 --> 00:08:06,319
although we have some milestones there's

219
00:08:11,909 --> 00:08:09,840
a lot of wiggle room in terms of

220
00:08:13,670 --> 00:08:11,919
hour by hour basis so we have to be

221
00:08:15,189 --> 00:08:13,680
flexible although you say hey number one

222
00:08:17,670 --> 00:08:15,199
priority number two priority there's

223
00:08:20,230 --> 00:08:17,680
many times where we we flip number two

224
00:08:21,990 --> 00:08:20,240
ahead of number one still get both done

225
00:08:24,830 --> 00:08:22,000
but you have to be on your toes and

226
00:08:27,110 --> 00:08:24,840
prepared for whatever the day may lead

227
00:08:29,189 --> 00:08:27,120
to thank you for that michelle i mean

228
00:08:31,270 --> 00:08:29,199
it's a great look at atlo in general and

229
00:08:32,630 --> 00:08:31,280
you've mentioned some of the teens

230
00:08:33,750 --> 00:08:32,640
i want to come back to you in just a

231
00:08:35,430 --> 00:08:33,760
minute but i want to introduce our

232
00:08:37,750 --> 00:08:35,440
second speaker to talk a little bit more

233
00:08:40,070 --> 00:08:37,760
about this so our second speaker this

234
00:08:43,029 --> 00:08:40,080
evening is luis dominguez a system

235
00:08:45,590 --> 00:08:43,039
integration and test engineer at jpl

236
00:08:49,430 --> 00:08:45,600
since november of 2007.

237
00:08:51,910 --> 00:08:49,440
in 2017 and 2019 he was named as one of

238
00:08:54,389 --> 00:08:51,920

the 20 most influential latinos in tech

239
00:08:56,310 --> 00:08:54,399
by cnet and espanol he studied

240
00:08:58,470 --> 00:08:56,320
mechanical engineering at california

241
00:09:00,230 --> 00:08:58,480
state polytechnic university pomona just

242
00:09:01,509 --> 00:09:00,240
like michelle also studied at the same

243
00:09:03,110 --> 00:09:01,519
university

244
00:09:05,670 --> 00:09:03,120
but luis works in testing the

245
00:09:07,829 --> 00:09:05,680
electronics and software of robots that

246
00:09:10,470 --> 00:09:07,839
explore space he's serving as the

247
00:09:13,110 --> 00:09:10,480
electrical integration and test lead and

248
00:09:15,269 --> 00:09:13,120
deputy systems lead for the psyche atlo

249
00:09:17,110 --> 00:09:15,279
team and although he loves technical

250
00:09:19,430 --> 00:09:17,120
engineering analysis and programming his

251
00:09:21,430 --> 00:09:19,440
primary drive in his life is helping and

252
00:09:23,750 --> 00:09:21,440
inspiring others especially in his

253
00:09:26,470 --> 00:09:23,760
native los angeles so hi louise thanks

254
00:09:28,310 --> 00:09:26,480
for joining us this evening

255
00:09:29,750 --> 00:09:28,320
hi thanks for having me it's an absolute

256
00:09:31,670 --> 00:09:29,760
honor to be on here

257
00:09:33,910 --> 00:09:31,680
oh we are so glad you both are here this

258
00:09:35,509 --> 00:09:33,920
evening so luis i know you are on more

259
00:09:37,430 --> 00:09:35,519
of the electronic side michelle on more

260
00:09:39,110 --> 00:09:37,440
of the mechanical side so tell us what

261
00:09:41,509 --> 00:09:39,120
does electronics and testing look like

262
00:09:43,910 --> 00:09:41,519
for you during atlo

263
00:09:45,350 --> 00:09:43,920

yeah so um when we start off you know

264
00:09:47,269 --> 00:09:45,360
and just like the mechanical team we

265
00:09:49,190 --> 00:09:47,279
start off with a shell of a spacecraft

266
00:09:51,990 --> 00:09:49,200
you know it's really just a mechanical

267
00:09:54,070 --> 00:09:52,000
structure if you could go to uh

268
00:09:55,910 --> 00:09:54,080
image 10 there um

269
00:09:59,190 --> 00:09:55,920
essentially you just got a bare bone

270
00:10:00,310 --> 00:09:59,200
spacecraft and um you're going to

271
00:10:02,389 --> 00:10:00,320
receive

272
00:10:03,990 --> 00:10:02,399
several different boxes and units and

273
00:10:05,910 --> 00:10:04,000
different instruments from sometimes all

274
00:10:08,550 --> 00:10:05,920
around the world and start mounting

275
00:10:09,990 --> 00:10:08,560
these things into the spacecraft um the

276
00:10:11,829 --> 00:10:10,000
planning starts from the beginning right

277
00:10:13,670 --> 00:10:11,839
right from the proposal stage where

278
00:10:16,150 --> 00:10:13,680
they're developing the the actual

279
00:10:17,590 --> 00:10:16,160
mission and we we come up with this

280
00:10:19,750 --> 00:10:17,600
thing called the rectal list which is

281
00:10:21,350 --> 00:10:19,760
the receiving and delivery list

282
00:10:23,990 --> 00:10:21,360
and everyone kind of agrees to deliver

283
00:10:26,150 --> 00:10:24,000
things in a certain order um and that

284
00:10:28,389 --> 00:10:26,160
kind of dictates the overall flow um for

285
00:10:30,230 --> 00:10:28,399
the for the integration and test uh team

286
00:10:32,790 --> 00:10:30,240
the atlo team overall

287
00:10:35,030 --> 00:10:32,800
and uh as usual though uh

288
00:10:36,790 --> 00:10:35,040

that hardly ever goes to plan and uh

289
00:10:39,030 --> 00:10:36,800
some things come in early that you

290
00:10:40,870 --> 00:10:39,040
expect to come in uh late and then

291
00:10:43,030 --> 00:10:40,880
sometimes things that are coming in late

292
00:10:44,710 --> 00:10:43,040
come in early and so you have to pivot

293
00:10:46,150 --> 00:10:44,720
you know that's where the the strategic

294
00:10:47,269 --> 00:10:46,160
planning and the tactical planning that

295
00:10:49,670 --> 00:10:47,279
we go through

296
00:10:52,069 --> 00:10:49,680
with the mechanical team um and the rest

297
00:10:54,310 --> 00:10:52,079
of the other teams on the on the project

298
00:10:56,069 --> 00:10:54,320
um and kind of decide how we're gonna go

299
00:10:57,910 --> 00:10:56,079
along with that flow because there's a

300
00:10:59,350 --> 00:10:57,920
lot of things that need to come together

301
00:11:02,310 --> 00:10:59,360
you've got software that needs to get

302
00:11:04,069 --> 00:11:02,320
developed um and then uh there isn't a

303
00:11:06,470 --> 00:11:04,079
certain order of operations right that

304
00:11:08,870 --> 00:11:06,480
you put together this this lego block uh

305
00:11:10,230 --> 00:11:08,880
all right and so if you if you get a

306
00:11:13,110 --> 00:11:10,240
certain piece of hardware and you have

307
00:11:15,110 --> 00:11:13,120
to sometimes decide not to install it um

308
00:11:16,470 --> 00:11:15,120
because it'll prohibit you from trying

309
00:11:19,030 --> 00:11:16,480
to get something else done a little bit

310
00:11:21,110 --> 00:11:19,040
later or if you do install it then you

311
00:11:22,949 --> 00:11:21,120
need to remove it and then you know

312
00:11:24,310 --> 00:11:22,959
reinstall it a little bit later and

313
00:11:25,670 --> 00:11:24,320

sometimes things are a little more

314
00:11:27,269 --> 00:11:25,680
difficult to get off of the spacecraft

315
00:11:29,030 --> 00:11:27,279
once you mount them on

316
00:11:31,190 --> 00:11:29,040
so um

317
00:11:32,150 --> 00:11:31,200
as these computers are as these boxes

318
00:11:33,829 --> 00:11:32,160
are all getting mounted on the

319
00:11:35,750 --> 00:11:33,839
spacecraft and instruments uh you can

320
00:11:37,670 --> 00:11:35,760
kind of think of a spacecraft as a bunch

321
00:11:39,269 --> 00:11:37,680
of computers that all speak a different

322
00:11:40,710 --> 00:11:39,279
language each and you're you're just

323
00:11:41,910 --> 00:11:40,720
trying to get them all to talk to each

324
00:11:43,829 --> 00:11:41,920
other and make sure that they're

325
00:11:46,069 --> 00:11:43,839
following all the appropriate protocols

326
00:11:47,509 --> 00:11:46,079
that that have been established

327
00:11:49,750 --> 00:11:47,519
for the interfaces that they're get that

328
00:11:50,790 --> 00:11:49,760
they're going to use to communicate um

329
00:11:52,870 --> 00:11:50,800
and so

330
00:11:54,550 --> 00:11:52,880
and then as we're integrating it we have

331
00:11:56,389 --> 00:11:54,560
to make sure that it's going to do its

332
00:11:58,389 --> 00:11:56,399
job in space and so

333
00:12:01,910 --> 00:11:58,399
um we we take it through a series of

334
00:12:05,030 --> 00:12:01,920
tests if we go to uh to image uh three

335
00:12:07,750 --> 00:12:05,040
um so uh in image three uh this is kind

336
00:12:11,190 --> 00:12:07,760
of the setup for uh emi emc tests where

337
00:12:13,190 --> 00:12:11,200
we where we uh expose the spacecraft to

338
00:12:14,949 --> 00:12:13,200

electromagnetic interference and make

339
00:12:16,230 --> 00:12:14,959
sure that all the different boxes that

340
00:12:18,230 --> 00:12:16,240
are going to be in there are are

341
00:12:19,670 --> 00:12:18,240
compatible with each other but you don't

342
00:12:21,269 --> 00:12:19,680
think about it sometimes but the

343
00:12:23,030 --> 00:12:21,279
different frequencies that all that all

344
00:12:25,190 --> 00:12:23,040
these boxes work at can sometimes cause

345
00:12:27,030 --> 00:12:25,200
interactions that you don't expect um

346
00:12:29,509 --> 00:12:27,040
and those interactions can be

347
00:12:31,030 --> 00:12:29,519
catastrophic in space um so we got to

348
00:12:32,230 --> 00:12:31,040
make sure that everything can talk to

349
00:12:34,230 --> 00:12:32,240
each other and that it's not going to

350
00:12:35,350 --> 00:12:34,240
interfere with each other and then that

351
00:12:36,949 --> 00:12:35,360
we're not going to interfere with

352
00:12:38,550 --> 00:12:36,959
anything on the launch pad so that's one

353
00:12:40,629 --> 00:12:38,560
of the other big tests where

354
00:12:42,550 --> 00:12:40,639
we need to make sure that any of the rf

355
00:12:45,269 --> 00:12:42,560
um emissions that the spacecraft

356
00:12:47,910 --> 00:12:45,279
actually gives off aren't gonna somehow

357
00:12:49,750 --> 00:12:47,920
uh cause the the rocket to self-destruct

358
00:12:51,269 --> 00:12:49,760
because like there's certain frequencies

359
00:12:52,710 --> 00:12:51,279
that the rocket has that it will

360
00:12:54,949 --> 00:12:52,720
self-destruct itself that and that's

361
00:12:56,629 --> 00:12:54,959
that's how things are designed so um

362
00:12:58,870 --> 00:12:56,639
it's a it's an interesting uh kind of

363
00:13:01,350 --> 00:12:58,880

test and then if we go to like uh image

364
00:13:03,030 --> 00:13:01,360
11 um we can see that this is we'll

365
00:13:05,190 --> 00:13:03,040
actually put it in a

366
00:13:06,550 --> 00:13:05,200
kind of a faraday cage so we'll create a

367
00:13:08,710 --> 00:13:06,560
giant um

368
00:13:10,150 --> 00:13:08,720
enclosure that kind of shields the

369
00:13:13,110 --> 00:13:10,160
spacecraft from the rest of the

370
00:13:15,110 --> 00:13:13,120
environment and we can actually get um

371
00:13:16,550 --> 00:13:15,120
closer to those emi and emc tests that

372
00:13:18,069 --> 00:13:16,560
we want to see and make sure that we're

373
00:13:18,949 --> 00:13:18,079
not over certain levels and things like

374
00:13:21,430 --> 00:13:18,959
that

375
00:13:23,829 --> 00:13:21,440
and uh then we'll take it to t vac which

376
00:13:25,110 --> 00:13:23,839
is uh if we go to image five um uh

377
00:13:27,670 --> 00:13:25,120
michelle kind of filled this image a

378
00:13:29,269 --> 00:13:27,680
little bit earlier um where you know

379
00:13:31,269 --> 00:13:29,279
this is the psyche spacecraft where we

380
00:13:32,069 --> 00:13:31,279
actually had you know our t-vac chamber

381
00:13:34,629 --> 00:13:32,079
is

382
00:13:37,509 --> 00:13:34,639
capable of stimulating the sun right and

383
00:13:40,069 --> 00:13:37,519
we've used it for countless missions at

384
00:13:43,110 --> 00:13:40,079
jpl um but for psyche we actually had to

385
00:13:45,990 --> 00:13:43,120
build a a toaster oven um slash cooling

386
00:13:48,069 --> 00:13:46,000
uh cook slash refrigerator or freezer um

387
00:13:49,509 --> 00:13:48,079
to kind of be able to simulate um

388
00:13:51,509 --> 00:13:49,519

cooling and heating all the different

389
00:13:52,949 --> 00:13:51,519
sides of the spacecraft to to make sure

390
00:13:55,670 --> 00:13:52,959
that the spacecraft's going to do what

391
00:13:57,110 --> 00:13:55,680
it needs to do when it's in space

392
00:13:58,550 --> 00:13:57,120
and that all the materials that are on

393
00:14:00,470 --> 00:13:58,560
it aren't going to start falling apart

394
00:14:02,310 --> 00:14:00,480
because space is an interesting

395
00:14:04,230 --> 00:14:02,320
interesting place because you don't have

396
00:14:06,310 --> 00:14:04,240
a you're in a vacuum right and so things

397
00:14:08,069 --> 00:14:06,320
start outgassing that you don't expect

398
00:14:10,949 --> 00:14:08,079
and materials can actually start falling

399
00:14:13,750 --> 00:14:10,959
apart um so it's a

400
00:14:15,509 --> 00:14:13,760
it's a great great uh great little test

401
00:14:17,030 --> 00:14:15,519
for the spacecraft there

402
00:14:19,990 --> 00:14:17,040
and then we go into a dynamics test

403
00:14:22,230 --> 00:14:20,000
campaign um and we also do all sorts of

404
00:14:23,430 --> 00:14:22,240
different tests so if we go to image 12

405
00:14:25,910 --> 00:14:23,440
we can see

406
00:14:27,430 --> 00:14:25,920
this is a solar array deployment test

407
00:14:29,750 --> 00:14:27,440
where we actually

408
00:14:31,189 --> 00:14:29,760
deploy the solar arrays here on earth to

409
00:14:32,790 --> 00:14:31,199
make sure that they're going to work in

410
00:14:34,069 --> 00:14:32,800
space and in order to do that you

411
00:14:35,590 --> 00:14:34,079
actually have to build this giant

412
00:14:36,790 --> 00:14:35,600
structure that michelle's team pulls

413
00:14:38,870 --> 00:14:36,800

together

414
00:14:40,310 --> 00:14:38,880
to actually offload the weight

415
00:14:41,750 --> 00:14:40,320
from the from the solar arrays because

416
00:14:43,750 --> 00:14:41,760
they're designed to deploy in space

417
00:14:45,509 --> 00:14:43,760
they're not designed to deploy here on

418
00:14:47,509 --> 00:14:45,519
earth uh you know they would fall apart

419
00:14:49,910 --> 00:14:47,519
basically out of off their own weight if

420
00:14:51,030 --> 00:14:49,920
we didn't fill this giant fixture

421
00:14:52,790 --> 00:14:51,040
um

422
00:14:55,509 --> 00:14:52,800
and and we do a series of other tests

423
00:14:56,310 --> 00:14:55,519
you know uh the next slide slide 13

424
00:14:58,389 --> 00:14:56,320
um

425
00:15:00,150 --> 00:14:58,399
shows the our spin table test so where

426
00:15:03,110 --> 00:15:00,160
we actually spin it to get the mass

427
00:15:05,030 --> 00:15:03,120
properties of the spacecraft um and so

428
00:15:07,430 --> 00:15:05,040
um that's that's a very important test

429
00:15:09,030 --> 00:15:07,440
and it gives us a lot of information um

430
00:15:12,069 --> 00:15:09,040
and then once we we've done all these

431
00:15:14,150 --> 00:15:12,079
environmental tests we move on to uh

432
00:15:15,590 --> 00:15:14,160
transporting the spacecraft right on so

433
00:15:17,030 --> 00:15:15,600
image 14

434
00:15:19,269 --> 00:15:17,040
will show uh

435
00:15:21,670 --> 00:15:19,279
the spacecraft essentially packaged up

436
00:15:23,910 --> 00:15:21,680
and ready to go um and that's me uh

437
00:15:25,990 --> 00:15:23,920
saying goodbye uh to jpl

438
00:15:28,470 --> 00:15:26,000

as we left to florida uh recently for

439
00:15:30,389 --> 00:15:28,480
psyche um and then

440
00:15:32,310 --> 00:15:30,399
back at you know we have to take it

441
00:15:33,749 --> 00:15:32,320
apart usually when we ship it out

442
00:15:36,230 --> 00:15:33,759
because you know you usually can't ship

443
00:15:38,550 --> 00:15:36,240
the whole spacecraft as as one whole

444
00:15:41,030 --> 00:15:38,560
unit and uh sometimes you need to send

445
00:15:42,790 --> 00:15:41,040
um parts out to go get reworked or get

446
00:15:44,389 --> 00:15:42,800
some additional work done to them

447
00:15:47,670 --> 00:15:44,399
because through testing you found that

448
00:15:49,990 --> 00:15:47,680
they didn't work um and so but at some

449
00:15:51,590 --> 00:15:50,000
point um if you go to image 15 once

450
00:15:52,550 --> 00:15:51,600
you've got the spacecraft all packaged

451
00:15:54,150 --> 00:15:52,560
up

452
00:15:56,790 --> 00:15:54,160
you get the opportunity to encapsulate

453
00:15:58,389 --> 00:15:56,800
it right and uh as you encapsulate it

454
00:16:00,470 --> 00:15:58,399
this is essentially the last time you'll

455
00:16:02,310 --> 00:16:00,480
you'll see the spacecraft um it's a

456
00:16:04,069 --> 00:16:02,320
little different for for 2020 we

457
00:16:05,990 --> 00:16:04,079
actually had to integrate the

458
00:16:09,110 --> 00:16:06,000
radioactive thermonuclear generator so

459
00:16:10,629 --> 00:16:09,120
it wasn't the last time we'd see it um

460
00:16:14,310 --> 00:16:10,639
there were little uh doors there for us

461
00:16:15,749 --> 00:16:14,320
to integrate that that generator um but

462
00:16:18,150 --> 00:16:15,759
you know we we

463
00:16:21,030 --> 00:16:18,160

once we've encapsulated we put it onto

464
00:16:24,550 --> 00:16:21,040
the rocket um so image 16

465
00:16:26,629 --> 00:16:24,560
um and uh as you said we we've shaken it

466
00:16:30,389 --> 00:16:26,639
we've baked it and uh now we're ready to

467
00:16:31,749 --> 00:16:30,399
launch it so uh image 17 um we'll show

468
00:16:33,670 --> 00:16:31,759
you uh

469
00:16:34,710 --> 00:16:33,680
what what that more or less looks like

470
00:16:36,470 --> 00:16:34,720
and um

471
00:16:38,310 --> 00:16:36,480
and it takes a giant team to pull this

472
00:16:39,350 --> 00:16:38,320
together as michelle said um we all work

473
00:16:41,110 --> 00:16:39,360
together

474
00:16:43,829 --> 00:16:41,120
um it's not

475
00:16:46,310 --> 00:16:43,839
and you know it's not easy um but uh and

476
00:16:48,550 --> 00:16:46,320
mistakes will get made but we we get

477
00:16:53,269 --> 00:16:48,560
through them as a team and uh we pull it

478
00:16:56,310 --> 00:16:54,949
i mean you said it yourself teamwork

479
00:16:58,150 --> 00:16:56,320
right both you and michelle have brought

480
00:16:59,670 --> 00:16:58,160
that up so much so let's bring michelle

481
00:17:02,629 --> 00:16:59,680
back into the conversation so you both

482
00:17:03,990 --> 00:17:02,639
can team up for this next question um we

483
00:17:05,429 --> 00:17:04,000
want to hear about some of the

484
00:17:07,750 --> 00:17:05,439
challenges or as you said the

485
00:17:09,829 --> 00:17:07,760
opportunities for flexibility and at low

486
00:17:11,429 --> 00:17:09,839
so michelle let's jump off with you tell

487
00:17:14,150 --> 00:17:11,439
me about some of those opportunities for

488
00:17:16,710 --> 00:17:14,160

flexibility in atlo

489
00:17:19,110 --> 00:17:16,720
yeah so we we try and be as proactive as

490
00:17:20,789 --> 00:17:19,120
we can as early as we can so we have the

491
00:17:22,549 --> 00:17:20,799
tactical schedule we have our strategic

492
00:17:24,230 --> 00:17:22,559
schedule so looking short-term looking

493
00:17:26,630 --> 00:17:24,240
at long-term

494
00:17:28,870 --> 00:17:26,640
it's really a guideline overall because

495
00:17:32,710 --> 00:17:28,880
there's so many things that are changing

496
00:17:34,630 --> 00:17:32,720
on a sometimes hourly basis where

497
00:17:36,230 --> 00:17:34,640
we we were short of fastener we can't

498
00:17:38,230 --> 00:17:36,240
proceed with this installation we need

499
00:17:39,669 --> 00:17:38,240
to go and find something or someone

500
00:17:40,950 --> 00:17:39,679
called off sick today and they were

501
00:17:42,870 --> 00:17:40,960
pivotal in this

502
00:17:44,470 --> 00:17:42,880
operation and we we don't feel

503
00:17:47,350 --> 00:17:44,480
comfortable moving forward until we get

504
00:17:50,150 --> 00:17:47,360
them back so we really have to stay on

505
00:17:52,070 --> 00:17:50,160
our toes rely very heavily on each other

506
00:17:54,070 --> 00:17:52,080
to really have that transparency and

507
00:17:55,669 --> 00:17:54,080
openness and honesty with each other as

508
00:17:57,110 --> 00:17:55,679
well where if we're not comfortable

509
00:17:59,110 --> 00:17:57,120
doing something if we say hey the

510
00:18:01,669 --> 00:17:59,120
paperwork isn't as refined as it needs

511
00:18:02,549 --> 00:18:01,679
to be i don't want to risk it everyone

512
00:18:04,549 --> 00:18:02,559
really

513
00:18:07,110 --> 00:18:04,559

has an appreciation and that's something

514
00:18:09,510 --> 00:18:07,120
that is really hard to find but everyone

515
00:18:11,270 --> 00:18:09,520
has this sense of ownership appreciation

516
00:18:13,590 --> 00:18:11,280
and passion for what we do

517
00:18:16,470 --> 00:18:13,600
that the last thing we want to do is not

518
00:18:18,870 --> 00:18:16,480
be fully prepared to do an operation

519
00:18:21,669 --> 00:18:18,880
still proceed with it and possibly mess

520
00:18:23,270 --> 00:18:21,679
it up so we we're really flexible we pay

521
00:18:25,350 --> 00:18:23,280
so much attention to detail we want to

522
00:18:26,950 --> 00:18:25,360
make sure that we have all of our ducks

523
00:18:28,470 --> 00:18:26,960
in a row before we actually start

524
00:18:30,870 --> 00:18:28,480
executing something

525
00:18:33,190 --> 00:18:30,880
because we all know what's at stake

526
00:18:35,590 --> 00:18:33,200
and and with the outlook schedule right

527
00:18:38,710 --> 00:18:35,600
as as deliveries come to us later and

528
00:18:40,150 --> 00:18:38,720
later because they come they they face

529
00:18:41,029 --> 00:18:40,160
their own like certain pieces of

530
00:18:43,190 --> 00:18:41,039
hardware

531
00:18:45,510 --> 00:18:43,200
overcome their own issues in their sub

532
00:18:47,270 --> 00:18:45,520
assembly level testing so not only do

533
00:18:49,510 --> 00:18:47,280
they they fabricate they assemble they

534
00:18:51,750 --> 00:18:49,520
test it then they hand it over to atlo

535
00:18:53,270 --> 00:18:51,760
and then we do things at a a more system

536
00:18:55,110 --> 00:18:53,280
or spacecraft level or smaller

537
00:18:57,270 --> 00:18:55,120
subassembly level

538
00:18:58,870 --> 00:18:57,280

but a lot of times they identify some

539
00:19:01,430 --> 00:18:58,880
issues with the hardware before it comes

540
00:19:02,789 --> 00:19:01,440
to us which is exactly why we test it at

541
00:19:05,029 --> 00:19:02,799
that level before testing it at a

542
00:19:06,710 --> 00:19:05,039
spacecraft level so sometimes it takes a

543
00:19:08,710 --> 00:19:06,720
little bit longer for them to rework and

544
00:19:10,630 --> 00:19:08,720
and debug these issues so that when they

545
00:19:12,470 --> 00:19:10,640
deliver it to us it's in the the most

546
00:19:14,150 --> 00:19:12,480
confident and comfortable and perfect

547
00:19:15,669 --> 00:19:14,160
state that they feel that it is ready to

548
00:19:17,510 --> 00:19:15,679
do what it needs to do

549
00:19:18,950 --> 00:19:17,520
and so sometimes that isn't on the day

550
00:19:21,190 --> 00:19:18,960
that was originally on either our

551
00:19:23,029 --> 00:19:21,200
tactical or our strategic schedule so we

552
00:19:24,950 --> 00:19:23,039
need to like we said reshuffle things

553
00:19:27,110 --> 00:19:24,960
around make sure that we still have

554
00:19:28,789 --> 00:19:27,120
access to get to that part if it comes

555
00:19:31,510 --> 00:19:28,799
in late

556
00:19:34,630 --> 00:19:31,520
but also being mindful that our schedule

557
00:19:37,110 --> 00:19:34,640
does get compressed when this hardware

558
00:19:39,590 --> 00:19:37,120
gets delivered later and later to us we

559
00:19:41,350 --> 00:19:39,600
can't just move launch dates out a

560
00:19:43,430 --> 00:19:41,360
couple weeks here and there especially

561
00:19:45,909 --> 00:19:43,440
with the planetary launches

562
00:19:47,990 --> 00:19:45,919
you've got only a certain time within a

563
00:19:50,230 --> 00:19:48,000

certain year account before your next

564
00:19:52,549 --> 00:19:50,240
opportunity that you have to hit so it's

565
00:19:54,789 --> 00:19:52,559
a lot of just constant re-juggling and

566
00:19:57,590 --> 00:19:54,799
reshuffling of the activities while

567
00:19:59,510 --> 00:19:57,600
still maintaining the big picture goals

568
00:20:01,350 --> 00:19:59,520
make making sure that you're not doing

569
00:20:03,430 --> 00:20:01,360
anything out of order where you're

570
00:20:06,310 --> 00:20:03,440
you're setting yourself up for failure

571
00:20:08,230 --> 00:20:06,320
but still maintaining constant momentum

572
00:20:12,470 --> 00:20:08,240
across the whole team to be able to get

573
00:20:16,789 --> 00:20:14,789
that sounds very complicated and we are

574
00:20:18,630 --> 00:20:16,799
all glad you do the work but luis tell

575
00:20:20,549 --> 00:20:18,640
me about some of the opportunities for

576
00:20:22,950 --> 00:20:20,559
flexibility that you get a chance to

577
00:20:25,590 --> 00:20:22,960
deal with in atlo

578
00:20:27,750 --> 00:20:25,600
yeah i mean atlo's fun um but but it's

579
00:20:30,230 --> 00:20:27,760
brutal you know it takes a takes a toll

580
00:20:32,789 --> 00:20:30,240
on you you're constantly have to be on

581
00:20:34,950 --> 00:20:32,799
your toes um and just at the top of your

582
00:20:36,310 --> 00:20:34,960
game and as michelle said you know if

583
00:20:37,909 --> 00:20:36,320
you're not feeling up to it you know

584
00:20:39,909 --> 00:20:37,919
it's just you know you have to be

585
00:20:41,830 --> 00:20:39,919
willing uh to to say it yourself like

586
00:20:44,310 --> 00:20:41,840
i'm i can't come in today i can't do

587
00:20:46,310 --> 00:20:44,320
this today so you know we we need i need

588
00:20:49,110 --> 00:20:46,320

to take a break and and it's okay to do

589
00:20:51,270 --> 00:20:49,120
that you know we we have a big team

590
00:20:52,789 --> 00:20:51,280
and uh we have we have we usually have

591
00:20:55,590 --> 00:20:52,799
people who can come in and fill in for

592
00:20:58,070 --> 00:20:55,600
you and so um you know we're constantly

593
00:20:59,510 --> 00:20:58,080
juggling people around um but sometimes

594
00:21:01,270 --> 00:20:59,520
as michelle said you need someone who's

595
00:21:04,070 --> 00:21:01,280
critical for the operation

596
00:21:06,549 --> 00:21:04,080
or or you know you need to you need to

597
00:21:08,470 --> 00:21:06,559
for some for some cases you need to do

598
00:21:09,990 --> 00:21:08,480
uh specialized testing like you'll need

599
00:21:12,789 --> 00:21:10,000
to use a radiation source so you'll need

600
00:21:15,510 --> 00:21:12,799
to use um you know create a a little

601
00:21:17,510 --> 00:21:15,520
vacuum chamber for for example for our

602
00:21:20,149 --> 00:21:17,520
grns instrument we have to basically

603
00:21:21,830 --> 00:21:20,159
create a little vacuum chamber around it

604
00:21:23,830 --> 00:21:21,840
and get that set up and then that needs

605
00:21:25,990 --> 00:21:23,840
to pump down for several days and we

606
00:21:27,990 --> 00:21:26,000
need to support it you know on a 24-hour

607
00:21:29,830 --> 00:21:28,000
basis for for several days as it's

608
00:21:32,470 --> 00:21:29,840
pumping down to achieve the vacuum that

609
00:21:34,390 --> 00:21:32,480
way we can actually test out um

610
00:21:35,990 --> 00:21:34,400
bringing a radiation source to it and

611
00:21:38,070 --> 00:21:36,000
someone you know will come bring that

612
00:21:39,510 --> 00:21:38,080
radiation source and you know bring it

613
00:21:41,110 --> 00:21:39,520

near the instrument and then the

614
00:21:43,270 --> 00:21:41,120
instrument will detect the the gamma

615
00:21:45,990 --> 00:21:43,280
rays and then you know

616
00:21:47,510 --> 00:21:46,000
we had spent three days you know in uh

617
00:21:51,190 --> 00:21:47,520
essentially creating this little vacuum

618
00:21:54,149 --> 00:21:51,200
chamber so um it's tough um you know um

619
00:21:56,230 --> 00:21:54,159
but you know overall the the team loves

620
00:21:59,350 --> 00:21:56,240
it and the the team uh you know does a

621
00:22:01,909 --> 00:21:59,360
great job of pulling it together

622
00:22:03,830 --> 00:22:01,919
yeah you do some amazing teamwork to get

623
00:22:05,270 --> 00:22:03,840
this stuff done and i mean we even

624
00:22:07,669 --> 00:22:05,280
talked about the fact that you have to

625
00:22:09,909 --> 00:22:07,679
create specialized tools to do certain

626
00:22:12,390 --> 00:22:09,919
things that uh you know you have to

627
00:22:14,070 --> 00:22:12,400
travel across state lines to transport

628
00:22:15,750 --> 00:22:14,080
this stuff and so the work you do is

629
00:22:17,909 --> 00:22:15,760
really great and i'm sure that the

630
00:22:19,350 --> 00:22:17,919
audience has been really keyed in to

631
00:22:21,350 --> 00:22:19,360
what you're talking about and has a ton

632
00:22:23,590 --> 00:22:21,360
of great questions so brian tell us what

633
00:22:25,669 --> 00:22:23,600
are they asking out there

634
00:22:27,110 --> 00:22:25,679
oh there's so many great questions it's

635
00:22:29,669 --> 00:22:27,120
hard gonna be hard to get to all of them

636
00:22:31,190 --> 00:22:29,679
tonight um but somebody on youtube wants

637
00:22:32,630 --> 00:22:31,200
to know and maybe luis you can start

638
00:22:33,830 --> 00:22:32,640

with this because you kind of just were

639
00:22:36,310 --> 00:22:33,840
talking about it a little bit with

640
00:22:37,909 --> 00:22:36,320
hardware getting more and more advanced

641
00:22:39,430 --> 00:22:37,919
how do you test for more of these

642
00:22:41,750 --> 00:22:39,440
extreme conditions that it might

643
00:22:43,750 --> 00:22:41,760
experience

644
00:22:46,390 --> 00:22:43,760
yeah absolutely and like i said we have

645
00:22:48,230 --> 00:22:46,400
to get creative with it um literally the

646
00:22:51,590 --> 00:22:48,240
instrument team that delivered the the

647
00:22:53,669 --> 00:22:51,600
drns instrument to us um delivered a

648
00:22:55,909 --> 00:22:53,679
essentially a portable little vacuum

649
00:22:58,230 --> 00:22:55,919
chamber that they could wrap around the

650
00:22:59,990 --> 00:22:58,240
around the instrument um while not

651
00:23:01,830 --> 00:23:00,000
having to expose the whole spacecraft to

652
00:23:03,909 --> 00:23:01,840
a vacuum chamber because you know for

653
00:23:06,149 --> 00:23:03,919
that we need to use our giant 25-foot

654
00:23:08,870 --> 00:23:06,159
vacuum chamber and to run that vacuum

655
00:23:10,789 --> 00:23:08,880
chamber it it takes a lot it takes a lot

656
00:23:12,789 --> 00:23:10,799
of time to pump down you're looking at

657
00:23:15,590 --> 00:23:12,799
about two or three days just to pump

658
00:23:17,590 --> 00:23:15,600
down to the vacuum to a vacuum level and

659
00:23:19,190 --> 00:23:17,600
even then we wouldn't be able to achieve

660
00:23:21,990 --> 00:23:19,200
the level that we need for that actual

661
00:23:23,990 --> 00:23:22,000
instrument um so even when we brought

662
00:23:25,590 --> 00:23:24,000
the spacecraft into that large vacuum

663
00:23:28,230 --> 00:23:25,600

chamber we actually had to use the

664
00:23:29,669 --> 00:23:28,240
smaller like portable vacuum chamber

665
00:23:32,789 --> 00:23:29,679
around the instrument to bring it down

666
00:23:36,230 --> 00:23:32,799
to even those lower levels so

667
00:23:37,990 --> 00:23:36,240
it gets harder um and and it's it's

668
00:23:39,510 --> 00:23:38,000
sometimes you know it's it's dangerous

669
00:23:41,350 --> 00:23:39,520
sometimes you're dealing with radiation

670
00:23:44,549 --> 00:23:41,360
sources right but like the radioactive

671
00:23:46,549 --> 00:23:44,559
thermonuclear generator um when when we

672
00:23:49,029 --> 00:23:46,559
practice we practice several times

673
00:23:50,950 --> 00:23:49,039
integrating that thing um as a team you

674
00:23:53,110 --> 00:23:50,960
know it's a mechanical and electrical

675
00:23:55,110 --> 00:23:53,120
operation and we practice you know

676
00:23:56,950 --> 00:23:55,120
someone would literally go in with one

677
00:23:58,950 --> 00:23:56,960
wrench start bolting something down and

678
00:24:00,230 --> 00:23:58,960
then they have to practice stepping away

679
00:24:01,669 --> 00:24:00,240
uh because you don't you want to limit

680
00:24:03,430 --> 00:24:01,679
your exposure levels right you want to

681
00:24:05,430 --> 00:24:03,440
make sure that everyone stays safe and

682
00:24:07,750 --> 00:24:05,440
within um you know

683
00:24:09,190 --> 00:24:07,760
acceptable exposure limits um and we

684
00:24:11,669 --> 00:24:09,200
understand that you know we're standing

685
00:24:13,669 --> 00:24:11,679
next to a fizzle material there and uh

686
00:24:15,190 --> 00:24:13,679
and we're working next to it but um you

687
00:24:16,870 --> 00:24:15,200
know it's kind of cool you can kind of

688
00:24:18,390 --> 00:24:16,880

cool feeling the heat from uh from a

689
00:24:21,110 --> 00:24:18,400
thermonuclear generator as you're kind

690
00:24:22,149 --> 00:24:21,120
of working on it

691
00:24:24,310 --> 00:24:22,159
all right

692
00:24:26,390 --> 00:24:24,320
well hayden on youtube asks michelle

693
00:24:27,750 --> 00:24:26,400
let's say this one's for you for someone

694
00:24:29,669 --> 00:24:27,760
that perhaps wanted to get into

695
00:24:31,590 --> 00:24:29,679
integration and testing in atmo how much

696
00:24:32,470 --> 00:24:31,600
opportunity is there for innovation and

697
00:24:35,669 --> 00:24:32,480
design

698
00:24:39,510 --> 00:24:37,590
yeah so there's i mean there's a ton of

699
00:24:41,590 --> 00:24:39,520
opportunities and and really what's

700
00:24:42,549 --> 00:24:41,600
character building is is a lot of us

701
00:24:45,190 --> 00:24:42,559
have

702
00:24:47,190 --> 00:24:45,200
built and delivered hardware so you get

703
00:24:49,190 --> 00:24:47,200
that sense of appreciation and and

704
00:24:50,789 --> 00:24:49,200
technical insight as to

705
00:24:53,510 --> 00:24:50,799
how hardware is designed what it's

706
00:24:55,750 --> 00:24:53,520
intended to do um solving a lot of those

707
00:24:58,310 --> 00:24:55,760
technical problems and typically that is

708
00:25:00,470 --> 00:24:58,320
a gateway into being on the floor during

709
00:25:03,190 --> 00:25:00,480
integration and test where you don't

710
00:25:04,950 --> 00:25:03,200
have a lot of the continuity early on

711
00:25:06,789 --> 00:25:04,960
since you weren't necessarily involved

712
00:25:08,789 --> 00:25:06,799
in the design of that that specific

713
00:25:11,029 --> 00:25:08,799

piece of hardware you're integrating so

714
00:25:13,430 --> 00:25:11,039
you really build a lot of your pre on

715
00:25:14,870 --> 00:25:13,440
your previous technical experience and

716
00:25:16,789 --> 00:25:14,880
an engineering intuition that you

717
00:25:18,470 --> 00:25:16,799
develop with the more items that you

718
00:25:20,149 --> 00:25:18,480
touch and

719
00:25:21,990 --> 00:25:20,159
like the previous question it asks it

720
00:25:23,590 --> 00:25:22,000
becomes more and more complex with the

721
00:25:26,149 --> 00:25:23,600
more complex missions that we're doing

722
00:25:28,950 --> 00:25:26,159
so we are always trying to adapt um if

723
00:25:30,470 --> 00:25:28,960
we can actually show slide four this is

724
00:25:33,269 --> 00:25:30,480
something that i think is going to be

725
00:25:36,310 --> 00:25:33,279
really really really telling is that

726
00:25:39,190 --> 00:25:36,320
every single operation that we do in

727
00:25:41,909 --> 00:25:39,200
atlo with the flight hardware takes

728
00:25:44,630 --> 00:25:41,919
literally an entire crew of design

729
00:25:46,789 --> 00:25:44,640
engineers and technicians to assemble

730
00:25:48,710 --> 00:25:46,799
what we call ground support equipment

731
00:25:50,630 --> 00:25:48,720
both mechanical and electrical and

732
00:25:53,830 --> 00:25:50,640
without that we really couldn't do

733
00:25:55,990 --> 00:25:53,840
anything so there is a a huge aspect of

734
00:25:58,230 --> 00:25:56,000
accommodation just to let us have the

735
00:26:01,830 --> 00:25:58,240
opportunity to test to move things

736
00:26:03,830 --> 00:26:01,840
around like here we have the mars 2020

737
00:26:05,590 --> 00:26:03,840
aeroshell that we were preparing to move

738
00:26:07,750 --> 00:26:05,600

off of a rotational fixture that our

739
00:26:09,430 --> 00:26:07,760
ground support team designed they

740
00:26:11,190 --> 00:26:09,440
designed all of the crane lift fixtures

741
00:26:13,190 --> 00:26:11,200
to be able to move and transport this

742
00:26:15,430 --> 00:26:13,200
thing and so there's a lot of thought

743
00:26:17,750 --> 00:26:15,440
there that we are constantly working to

744
00:26:19,990 --> 00:26:17,760
improve on constantly redesigning for

745
00:26:21,590 --> 00:26:20,000
every project because we have let's say

746
00:26:23,190 --> 00:26:21,600
a different launch vehicle interface

747
00:26:24,630 --> 00:26:23,200
sometimes we launch on a falcon heavy

748
00:26:27,190 --> 00:26:24,640
sometimes we launch on a falcon 9

749
00:26:29,190 --> 00:26:27,200
sometimes we launch on an atlas so a lot

750
00:26:32,630 --> 00:26:29,200
of those interfaces change a lot of the

751
00:26:34,710 --> 00:26:32,640
masses change a lot of the the the box

752
00:26:37,430 --> 00:26:34,720
footprints change so we are always

753
00:26:39,029 --> 00:26:37,440
having to adapt at various levels to be

754
00:26:40,789 --> 00:26:39,039
able to accommodate and actually do the

755
00:26:43,269 --> 00:26:40,799
spacecraft justice to meet our testing

756
00:26:45,750 --> 00:26:43,279
and integration goals so it really does

757
00:26:47,510 --> 00:26:45,760
take a lot of people with a lot of

758
00:26:49,669 --> 00:26:47,520
experience a lot of out of the box

759
00:26:51,350 --> 00:26:49,679
thinking trying to problem solve both

760
00:26:53,510 --> 00:26:51,360
issues big and small like how are we

761
00:26:55,750 --> 00:26:53,520
going to get a wrench in between these

762
00:26:56,870 --> 00:26:55,760
two pieces of hardware to torque this

763
00:26:59,669 --> 00:26:56,880

bolt where all of our standard

764
00:27:01,510 --> 00:26:59,679
conventional tools won't fit so it it's

765
00:27:03,590 --> 00:27:01,520
a lot of innovation both big and small

766
00:27:06,070 --> 00:27:03,600
sometimes for the smallest tasks but but

767
00:27:08,549 --> 00:27:06,080
overall just the logistical planning to

768
00:27:10,470 --> 00:27:08,559
actually execute is is sometimes even

769
00:27:12,070 --> 00:27:10,480
greater than scope than than some of the

770
00:27:15,190 --> 00:27:12,080
actual flight integration tasks

771
00:27:19,110 --> 00:27:17,110
it's you asked answered somebody else's

772
00:27:21,190 --> 00:27:19,120
question too they're asking if that's

773
00:27:23,750 --> 00:27:21,200
harder to design these tests than it is

774
00:27:25,350 --> 00:27:23,760
sometimes to build the spacecraft

775
00:27:28,310 --> 00:27:25,360
luis this one's for you jordan on

776
00:27:30,870 --> 00:27:28,320
linkedin asks is machine learning used

777
00:27:32,470 --> 00:27:30,880
to save simulation costs i'm guessing

778
00:27:33,830 --> 00:27:32,480
running programs and kind of testing it

779
00:27:36,070 --> 00:27:33,840
through the computer before you actually

780
00:27:39,430 --> 00:27:36,080
test the spacecraft

781
00:27:41,510 --> 00:27:39,440
yeah absolutely so uh for for mars 2020

782
00:27:43,750 --> 00:27:41,520
um we did a lot of closed loop

783
00:27:46,470 --> 00:27:43,760
simulations um on the actual flight

784
00:27:48,070 --> 00:27:46,480
vehicle um and we did a couple of closed

785
00:27:49,909 --> 00:27:48,080
loop simulation tests with the actual

786
00:27:51,909 --> 00:27:49,919
flight hardware and that's really just

787
00:27:53,269 --> 00:27:51,919
to characterize the the response of the

788
00:27:54,870 --> 00:27:53,279

hardware itself

789
00:27:57,029 --> 00:27:54,880
um but

790
00:27:58,389 --> 00:27:57,039
the bulk of the of the testing is

791
00:28:00,710 --> 00:27:58,399
actually done using monte carlo

792
00:28:02,549 --> 00:28:00,720
simulations and i would imagine that

793
00:28:03,990 --> 00:28:02,559
they're starting to use more machine

794
00:28:05,830 --> 00:28:04,000
learning techniques

795
00:28:07,830 --> 00:28:05,840
to try and you know make those monte

796
00:28:10,149 --> 00:28:07,840
carlo simulations go a little bit

797
00:28:13,510 --> 00:28:10,159
faster and a little bit better but

798
00:28:16,230 --> 00:28:13,520
overall um the edl team has does a great

799
00:28:17,990 --> 00:28:16,240
job of running all of those and by the

800
00:28:20,310 --> 00:28:18,000
time we get to atlo we're really just

801
00:28:22,549 --> 00:28:20,320
characterizing you know the response of

802
00:28:24,710 --> 00:28:22,559
a thruster uh when we send a command to

803
00:28:26,389 --> 00:28:24,720
to fire that thruster how quickly does

804
00:28:28,549 --> 00:28:26,399
the computer respond how quickly does

805
00:28:30,950 --> 00:28:28,559
the motor controller respond and so we

806
00:28:32,870 --> 00:28:30,960
can get all those little timing deltas

807
00:28:34,389 --> 00:28:32,880
so that they can further fine-tune

808
00:28:36,950 --> 00:28:34,399
their simulations and their test

809
00:28:41,110 --> 00:28:39,590
wonderful i'm going to combine these two

810
00:28:42,310 --> 00:28:41,120
questions because i think they they kind

811
00:28:44,310 --> 00:28:42,320
of go together

812
00:28:45,750 --> 00:28:44,320
uh both from linkedin though and

813
00:28:47,909 --> 00:28:45,760

somebody asked what are the factors that

814
00:28:50,310 --> 00:28:47,919
affect the quality of materials used in

815
00:28:52,630 --> 00:28:50,320
space and the follow-up to that would

816
00:28:54,789 --> 00:28:52,640
dings to the body of the spacecraft be a

817
00:28:57,029 --> 00:28:54,799
significant issue so michelle let's

818
00:28:59,430 --> 00:28:57,039
start with you

819
00:29:03,110 --> 00:28:59,440
yeah so so starting off with the dings

820
00:29:05,510 --> 00:29:03,120
um yes absolutely uh it absolutely

821
00:29:07,669 --> 00:29:05,520
warrants what we call a problem failure

822
00:29:09,029 --> 00:29:07,679
report right and and what we do is that

823
00:29:11,830 --> 00:29:09,039
is a document that is a piece of

824
00:29:14,630 --> 00:29:11,840
documentation that that we typically use

825
00:29:16,950 --> 00:29:14,640
um to identify an issue

826
00:29:19,190 --> 00:29:16,960
and then we do an assessment after that

827
00:29:21,029 --> 00:29:19,200
so it depends what is the size of the

828
00:29:22,789 --> 00:29:21,039
ding where is the ding located what

829
00:29:24,950 --> 00:29:22,799
material is the ding what are the

830
00:29:26,950 --> 00:29:24,960
temperature cycles that that piece of

831
00:29:28,870 --> 00:29:26,960
hardware with the ding is going to see

832
00:29:31,029 --> 00:29:28,880
is that going to have any structural

833
00:29:33,269 --> 00:29:31,039
impact to the overall

834
00:29:35,269 --> 00:29:33,279
success of the hardware so you bring in

835
00:29:37,350 --> 00:29:35,279
a team of analysts who who go through

836
00:29:38,789 --> 00:29:37,360
the stress analysis again we talk with

837
00:29:40,310 --> 00:29:38,799
the cognizant engineer we look at all

838
00:29:42,149 --> 00:29:40,320

the interacting pieces of hardware you

839
00:29:44,470 --> 00:29:42,159
look at the load path so you break it

840
00:29:47,110 --> 00:29:44,480
down into very fundamentals to see

841
00:29:49,990 --> 00:29:47,120
hey is this going to require one of two

842
00:29:52,149 --> 00:29:50,000
paths is it rework or is it a use as is

843
00:29:54,070 --> 00:29:52,159
or is it something where we it's so

844
00:29:55,909 --> 00:29:54,080
critical that we have to scrap it and

845
00:29:58,470 --> 00:29:55,919
pull our flight spare unit and

846
00:30:01,350 --> 00:29:58,480
reintegrate that so it's very

847
00:30:03,510 --> 00:30:01,360
circumstantial um but absolutely as soon

848
00:30:05,510 --> 00:30:03,520
as something's noticed as soon as as

849
00:30:07,350 --> 00:30:05,520
soon as someone sometimes even a tool

850
00:30:09,830 --> 00:30:07,360
you're torquing a tool and your hand

851
00:30:11,430 --> 00:30:09,840
slips and the wrench can hit something i

852
00:30:14,070 --> 00:30:11,440
mean that that

853
00:30:16,710 --> 00:30:14,080
it happens mistakes happen on the floor

854
00:30:18,630 --> 00:30:16,720
and it's it's no one's fault you have to

855
00:30:19,990 --> 00:30:18,640
always just support each other on the

856
00:30:21,669 --> 00:30:20,000
team because the more time and more

857
00:30:24,149 --> 00:30:21,679
exposure you have there something's

858
00:30:25,669 --> 00:30:24,159
bound to happen and it's really how you

859
00:30:28,710 --> 00:30:25,679
come out of it and recover as an

860
00:30:29,750 --> 00:30:28,720
individual as a team and then work the

861
00:30:31,830 --> 00:30:29,760
technical

862
00:30:34,389 --> 00:30:31,840
due diligence to make sure that that is

863
00:30:39,990 --> 00:30:34,399

acceptable or or take the right path to

864
00:30:43,669 --> 00:30:41,750
wonderful uh luis you have any follow-up

865
00:30:45,669 --> 00:30:43,679
with that too

866
00:30:47,190 --> 00:30:45,679
yeah i know i'm just going along with

867
00:30:48,870 --> 00:30:47,200
like you know sometimes using a tool

868
00:30:50,789 --> 00:30:48,880
you'll you'll you know do a ding or

869
00:30:52,470 --> 00:30:50,799
something or you'll drop a tool um you

870
00:30:54,470 --> 00:30:52,480
know it's very important uh as the

871
00:30:56,310 --> 00:30:54,480
outlet team like and we always we always

872
00:30:58,149 --> 00:30:56,320
share this with the team that you know

873
00:30:59,430 --> 00:30:58,159
be up front and let us know when

874
00:31:01,190 --> 00:30:59,440
something happens let us know when you

875
00:31:04,149 --> 00:31:01,200
see an issue let us know if you've made

876
00:31:05,350 --> 00:31:04,159
a mistake um because you know those even

877
00:31:07,269 --> 00:31:05,360
though you might not think it's a

878
00:31:09,029 --> 00:31:07,279
mistake you know you you stood up all of

879
00:31:09,669 --> 00:31:09,039
a sudden and you hit you know some piece

880
00:31:14,630 --> 00:31:09,679
of

881
00:31:15,830 --> 00:31:14,640
know let everyone know what happened and

882
00:31:18,230 --> 00:31:15,840
then we can make the assessment of

883
00:31:19,990 --> 00:31:18,240
whether there's an issue here or not um

884
00:31:21,590 --> 00:31:20,000
that way you know it's clear and it's up

885
00:31:23,590 --> 00:31:21,600
front and you know sometimes in outlaw

886
00:31:25,509 --> 00:31:23,600
you'll when you make a mistake um you

887
00:31:28,789 --> 00:31:25,519
know you you come out and you feel

888
00:31:30,230 --> 00:31:28,799

really crummy it's you know the it's

889
00:31:31,590 --> 00:31:30,240
gives you some of the best days of your

890
00:31:36,230 --> 00:31:31,600
life and it also gives you some of the

891
00:31:40,310 --> 00:31:39,269
i i imagine that would be true um

892
00:31:41,750 --> 00:31:40,320
i wanna

893
00:31:42,950 --> 00:31:41,760
i think we might have some images for

894
00:31:44,950 --> 00:31:42,960
this one people are asking how do you

895
00:31:45,990 --> 00:31:44,960
get the spacecraft to the launch site

896
00:31:49,990 --> 00:31:46,000
how do you get them to these other

897
00:31:55,190 --> 00:31:52,070
yeah so i will take this one um if we

898
00:31:59,590 --> 00:31:55,200
can go to slide eight

899
00:32:02,870 --> 00:31:59,600
um so a lot of times our spacecraft is

900
00:32:05,110 --> 00:32:02,880
so large that we require

901
00:32:07,430 --> 00:32:05,120
aircraft support to take it across

902
00:32:09,590 --> 00:32:07,440
country um a lot of times historically

903
00:32:12,549 --> 00:32:09,600
it's been driven across country with a

904
00:32:15,029 --> 00:32:12,559
convoy but what that does is it gives a

905
00:32:17,430 --> 00:32:15,039
lot of exposure for the spacecraft

906
00:32:19,190 --> 00:32:17,440
itself to be out in the environment

907
00:32:20,310 --> 00:32:19,200
although it's in a controlled shipping

908
00:32:22,230 --> 00:32:20,320
container

909
00:32:24,470 --> 00:32:22,240
i mean there's vibration from the road

910
00:32:26,789 --> 00:32:24,480
although you you take considerations for

911
00:32:27,669 --> 00:32:26,799
like an air ride suspension with your

912
00:32:29,830 --> 00:32:27,679
truck

913
00:32:32,230 --> 00:32:29,840

but in order to transport let's say from

914
00:32:33,269 --> 00:32:32,240
jpl to cape canaveral which we do very

915
00:32:34,549 --> 00:32:33,279
often

916
00:32:37,190 --> 00:32:34,559
we

917
00:32:39,990 --> 00:32:37,200
lately have been relying very heavily on

918
00:32:41,909 --> 00:32:40,000
on air transport with the use of a c17

919
00:32:43,190 --> 00:32:41,919
um so if we can actually show slide nine

920
00:32:45,990 --> 00:32:43,200
as well

921
00:32:47,110 --> 00:32:46,000
um it it really takes a

922
00:32:49,269 --> 00:32:47,120
large

923
00:32:50,789 --> 00:32:49,279
portion of our atlo team to support

924
00:32:52,470 --> 00:32:50,799
these operations and we work

925
00:32:54,389 --> 00:32:52,480
hand-in-hand with the air force to

926
00:32:57,430 --> 00:32:54,399
actually execute them because the air

927
00:33:00,149 --> 00:32:57,440
force is actually running the c17 their

928
00:33:02,549 --> 00:33:00,159
load master works hand in hand with our

929
00:33:04,710 --> 00:33:02,559
lead of the operation and they wench

930
00:33:07,029 --> 00:33:04,720
these uh shipping containers up into the

931
00:33:08,710 --> 00:33:07,039
back of the c17 they make sure things

932
00:33:11,269 --> 00:33:08,720
are strapped down with some of our

933
00:33:12,870 --> 00:33:11,279
sensitive hardware i mean we have to

934
00:33:14,950 --> 00:33:12,880
maintain let's say a super clean

935
00:33:17,190 --> 00:33:14,960
environment for some of our instruments

936
00:33:19,509 --> 00:33:17,200
where we have to maintain a constant

937
00:33:21,830 --> 00:33:19,519
nitrogen purge so let's say keep optics

938
00:33:23,990 --> 00:33:21,840

clean and we have to manage that during

939
00:33:26,230 --> 00:33:24,000
either a truck convoy or during air

940
00:33:27,830 --> 00:33:26,240
transport so there's a whole lot of

941
00:33:30,070 --> 00:33:27,840
planning and consideration that goes

942
00:33:32,310 --> 00:33:30,080
into this and to the point where it's

943
00:33:34,470 --> 00:33:32,320
almost a full-time job for a specific

944
00:33:36,710 --> 00:33:34,480
individual on the atlo team to really

945
00:33:38,630 --> 00:33:36,720
take ownership of all of the ground

946
00:33:40,950 --> 00:33:38,640
transports from building to building as

947
00:33:43,909 --> 00:33:40,960
well as the air transport there's a ton

948
00:33:46,630 --> 00:33:43,919
of permits for the road going from jpl

949
00:33:51,430 --> 00:33:46,640
to get to an air force base to even load

950
00:33:53,750 --> 00:33:51,440
it onto a c17 so it it's definitely a

951
00:33:55,190 --> 00:33:53,760
lot of work it takes a lot of planning

952
00:33:56,870 --> 00:33:55,200
and we do it with

953
00:33:59,190 --> 00:33:56,880
essentially the same amount of care we

954
00:34:01,590 --> 00:33:59,200
take when integrating an instrument

955
00:34:03,190 --> 00:34:01,600
um every eye needs to be dotted every t

956
00:34:04,870 --> 00:34:03,200
needs to be crossed because there's

957
00:34:07,350 --> 00:34:04,880
there's always there's so much at stake

958
00:34:08,629 --> 00:34:07,360
and we're constantly reminded of that

959
00:34:11,270 --> 00:34:08,639
and so

960
00:34:12,950 --> 00:34:11,280
even just wheeling it out right we want

961
00:34:15,109 --> 00:34:12,960
to make sure we're doing it slow and in

962
00:34:16,790 --> 00:34:15,119
a controlled way so that

963
00:34:21,829 --> 00:34:16,800

we don't have a runaway spacecraft

964
00:34:25,109 --> 00:34:23,430
there are so many great questions on

965
00:34:26,470 --> 00:34:25,119
here and i want to let you all know

966
00:34:27,909 --> 00:34:26,480
thank you for asking so many wonderful

967
00:34:28,790 --> 00:34:27,919
questions we've only got time for a few

968
00:34:30,950 --> 00:34:28,800
more

969
00:34:32,950 --> 00:34:30,960
um on youtube they want to know how do

970
00:34:34,310 --> 00:34:32,960
you keep the clean room spaces organized

971
00:34:36,230 --> 00:34:34,320
so there's enough room to fit all the

972
00:34:40,149 --> 00:34:36,240
big projects some of those photos look

973
00:34:46,470 --> 00:34:41,829
i'll let myself have that one that one's

974
00:34:52,629 --> 00:34:48,389
yeah so we

975
00:34:54,310 --> 00:34:52,639
uh short answer label makers um

976
00:34:56,470 --> 00:34:54,320
we label

977
00:34:58,069 --> 00:34:56,480
everything so that we know where it is

978
00:34:59,990 --> 00:34:58,079
there's a place for everything and

979
00:35:01,510 --> 00:35:00,000
everything has its place and that's

980
00:35:03,430 --> 00:35:01,520
almost

981
00:35:05,349 --> 00:35:03,440
the beginning of every day and the end

982
00:35:07,670 --> 00:35:05,359
of every day we make sure every tool is

983
00:35:10,310 --> 00:35:07,680
put back so that the next user can find

984
00:35:12,630 --> 00:35:10,320
it because we share tools amongst the

985
00:35:14,630 --> 00:35:12,640
clusters of us that are working in that

986
00:35:17,190 --> 00:35:14,640
space not everyone has their own

987
00:35:19,670 --> 00:35:17,200
dedicated toolbox not everyone has their

988
00:35:22,069 --> 00:35:19,680

their own dedicated torque wrench

989
00:35:25,510 --> 00:35:22,079
or their own dedicated workstation that

990
00:35:27,829 --> 00:35:25,520
stays and lives in that clean room so it

991
00:35:29,829 --> 00:35:27,839
definitely takes a lot um there's a lot

992
00:35:32,310 --> 00:35:29,839
of reshuffling depending on what

993
00:35:34,150 --> 00:35:32,320
hardware comes in what's next to go

994
00:35:36,150 --> 00:35:34,160
underneath the crane

995
00:35:38,310 --> 00:35:36,160
so if you notice if we actually go back

996
00:35:40,950 --> 00:35:38,320
to let's say slide four a lot of our

997
00:35:42,390 --> 00:35:40,960
scaffolding is on casters and we have

998
00:35:44,390 --> 00:35:42,400
jacks that

999
00:35:45,829 --> 00:35:44,400
we can raise the scaffolding on to get

1000
00:35:47,829 --> 00:35:45,839
them off the casters when someone needs

1001
00:35:50,390 --> 00:35:47,839
to stand on them but then when it's time

1002
00:35:52,550 --> 00:35:50,400
to move them they're very modular by

1003
00:35:54,069 --> 00:35:52,560
design so you can lower the jacks down

1004
00:35:56,230 --> 00:35:54,079
get back on the casters and if we need

1005
00:35:58,550 --> 00:35:56,240
to roll the scaffolding let's say to the

1006
00:36:00,630 --> 00:35:58,560
other side of the room to make way for

1007
00:36:02,470 --> 00:36:00,640
another piece of hardware or to make way

1008
00:36:05,750 --> 00:36:02,480
for a scissor lift to get a technician

1009
00:36:08,230 --> 00:36:05,760
up um we have that flexibility to do so

1010
00:36:09,829 --> 00:36:08,240
but we are constantly modeling in our

1011
00:36:11,829 --> 00:36:09,839
cad

1012
00:36:13,750 --> 00:36:11,839
we have a cat of the spacecraft facility

1013
00:36:16,069 --> 00:36:13,760

in and of itself with the floor plan and

1014
00:36:17,990 --> 00:36:16,079
we are constantly modeling

1015
00:36:19,510 --> 00:36:18,000
at this phase this is what we expect to

1016
00:36:21,670 --> 00:36:19,520
have this is the support equipment we

1017
00:36:22,950 --> 00:36:21,680
expect to have the flight hardware this

1018
00:36:25,270 --> 00:36:22,960
is the test equipment that's going to

1019
00:36:27,109 --> 00:36:25,280
come in and find out a way to make that

1020
00:36:29,030 --> 00:36:27,119
work where we have our doors cleared for

1021
00:36:31,430 --> 00:36:29,040
personnel access or if we're expecting a

1022
00:36:32,310 --> 00:36:31,440
big delivery we need to to constantly

1023
00:36:36,470 --> 00:36:32,320
have

1024
00:36:38,069 --> 00:36:36,480
like the actual activity planning a

1025
00:36:38,870 --> 00:36:38,079
baseline plan of where everything should

1026
00:36:40,790 --> 00:36:38,880
go

1027
00:36:42,790 --> 00:36:40,800
and and really you have to be reactive

1028
00:36:44,470 --> 00:36:42,800
on the fly that hey this may not work or

1029
00:36:47,270 --> 00:36:44,480
we think we need a little bit more space

1030
00:36:48,950 --> 00:36:47,280
here we then stop all the operations and

1031
00:36:51,990 --> 00:36:48,960
get the team and we're moving things

1032
00:36:54,310 --> 00:36:52,000
around so you have a plan in mind there

1033
00:36:56,310 --> 00:36:54,320
are slight deviations but it is it is

1034
00:36:58,390 --> 00:36:56,320
absolutely a lot of reshuffling

1035
00:37:01,190 --> 00:36:58,400
especially as our missions get larger

1036
00:37:04,630 --> 00:37:03,270
wonderful so many great okay we've got

1037
00:37:06,390 --> 00:37:04,640
time for two more

1038
00:37:08,790 --> 00:37:06,400

um this first one will be for both of

1039
00:37:11,030 --> 00:37:08,800
you but we'll start with louise on this

1040
00:37:12,950 --> 00:37:11,040
how long do you begin preparing in

1041
00:37:15,030 --> 00:37:12,960
advance for a launch and also how long

1042
00:37:16,390 --> 00:37:15,040
does it the main million dollar question

1043
00:37:20,710 --> 00:37:16,400
how long does it take to build a

1044
00:37:26,790 --> 00:37:23,829
so typically you so you start planning

1045
00:37:28,630 --> 00:37:26,800
for atlo right from the beginning so

1046
00:37:30,870 --> 00:37:28,640
like i said the moment the proposals

1047
00:37:33,190 --> 00:37:30,880
written for how this mission is going to

1048
00:37:35,349 --> 00:37:33,200
go they've already got a plan on how

1049
00:37:37,030 --> 00:37:35,359
atlo will be achieved and you're

1050
00:37:39,589 --> 00:37:37,040
typically looking for most atlo

1051
00:37:42,310 --> 00:37:39,599
campaigns a one to two year time frame

1052
00:37:44,150 --> 00:37:42,320
um and and it really depends on the

1053
00:37:46,870 --> 00:37:44,160
hardware delivery how early you're

1054
00:37:48,470 --> 00:37:46,880
expecting hardware to get in and um how

1055
00:37:51,510 --> 00:37:48,480
how quickly you can have the software

1056
00:37:54,069 --> 00:37:51,520
ready to test that hardware um so

1057
00:37:56,790 --> 00:37:54,079
for 2020 um that one was about an

1058
00:37:59,109 --> 00:37:56,800
18-month campaign i believe and for

1059
00:38:01,829 --> 00:37:59,119
psyche we are probably about similar

1060
00:38:03,910 --> 00:38:01,839
about an 18-month campaign as well um in

1061
00:38:06,630 --> 00:38:03,920
terms of assembly test and launch

1062
00:38:08,390 --> 00:38:06,640
operations for just that though

1063
00:38:13,030 --> 00:38:08,400

but it can vary i mean some some

1064
00:38:17,109 --> 00:38:14,630
michelle how long does it take to build

1065
00:38:19,670 --> 00:38:17,119
a spacecraft yeah

1066
00:38:22,790 --> 00:38:19,680
uh i mean it varies on the complexity of

1067
00:38:26,069 --> 00:38:22,800
the spacecraft it varies too on a lot of

1068
00:38:29,270 --> 00:38:26,079
the delineation between what happens

1069
00:38:31,349 --> 00:38:29,280
at the subsystem phase versus when

1070
00:38:33,829 --> 00:38:31,359
things are finally delivered to us to

1071
00:38:36,470 --> 00:38:33,839
atlo uh so a lot of times with the

1072
00:38:38,950 --> 00:38:36,480
course structure right you have there

1073
00:38:39,829 --> 00:38:38,960
there are opportunities where that team

1074
00:38:43,829 --> 00:38:39,839
had

1075
00:38:46,150 --> 00:38:43,839
groups on lab or with third party

1076
00:38:48,630 --> 00:38:46,160
commercial vendors to provide like an

1077
00:38:51,430 --> 00:38:48,640
electronics box or provide some on-board

1078
00:38:53,750 --> 00:38:51,440
propulsion or something of that nature

1079
00:38:55,910 --> 00:38:53,760
where they integrate to a certain extent

1080
00:38:56,950 --> 00:38:55,920
before it gets to atlo

1081
00:39:00,790 --> 00:38:56,960
so it's

1082
00:39:03,270 --> 00:39:00,800
it varies so much project by project um

1083
00:39:06,630 --> 00:39:03,280
but really the traditional yeah at lo

1084
00:39:09,190 --> 00:39:06,640
atlo timeline that luis was referring to

1085
00:39:11,589 --> 00:39:09,200
over an 18 month to about two year time

1086
00:39:14,230 --> 00:39:11,599
frame is is really what it takes and

1087
00:39:17,270 --> 00:39:14,240
it's not just all serially you build it

1088
00:39:18,310 --> 00:39:17,280

once and it's done it also maintains a

1089
00:39:22,710 --> 00:39:18,320
lot of

1090
00:39:24,710 --> 00:39:22,720
we're gonna go and test now we have to

1091
00:39:27,270 --> 00:39:24,720
take a lot of things off and reconfigure

1092
00:39:29,190 --> 00:39:27,280
and ship and then reinstall it at the

1093
00:39:31,109 --> 00:39:29,200
cape so it

1094
00:39:34,230 --> 00:39:31,119
it's a lot of

1095
00:39:35,670 --> 00:39:34,240
deviation and re reshuffling once again

1096
00:39:36,950 --> 00:39:35,680
it seems to be a very common theme in

1097
00:39:39,270 --> 00:39:36,960
atlo

1098
00:39:41,190 --> 00:39:39,280
but reshuffling of the hardware on and

1099
00:39:42,470 --> 00:39:41,200
off making sure that you're recording

1100
00:39:44,069 --> 00:39:42,480
the number of cycles that you do that

1101
00:39:45,990 --> 00:39:44,079
because that is very important we don't

1102
00:39:48,310 --> 00:39:46,000
want to take things off and put things

1103
00:39:49,829 --> 00:39:48,320
on too many times to where we start to

1104
00:39:51,430 --> 00:39:49,839
wear some of the

1105
00:39:53,270 --> 00:39:51,440
the main features of the of the

1106
00:39:55,270 --> 00:39:53,280
structural kind of bond of that

1107
00:39:58,310 --> 00:39:55,280
equipment um

1108
00:40:00,630 --> 00:39:58,320
but we also want to be mindful that

1109
00:40:02,630 --> 00:40:00,640
the first time you put it on you with

1110
00:40:05,030 --> 00:40:02,640
full intention you may want it to be the

1111
00:40:07,829 --> 00:40:05,040
last time but there are

1112
00:40:10,069 --> 00:40:07,839
very often circumstances where it comes

1113
00:40:13,589 --> 00:40:10,079

on and off so you need to maintain that

1114
00:40:16,309 --> 00:40:13,599
margin in your plan for flexibility for

1115
00:40:18,710 --> 00:40:16,319
the the planned the unplanned and the

1116
00:40:22,390 --> 00:40:18,720
recovery of something goes very far

1117
00:40:24,230 --> 00:40:22,400
accord according to plan

1118
00:40:26,150 --> 00:40:24,240
all right time for our last question and

1119
00:40:27,829 --> 00:40:26,160
i'll throw it back to nikki uh on

1120
00:40:30,630 --> 00:40:27,839
youtube they want to know if they wanted

1121
00:40:32,870 --> 00:40:30,640
to get into this field would you both of

1122
00:40:34,950 --> 00:40:32,880
you recommend mechanical engineering

1123
00:40:36,790 --> 00:40:34,960
astronomical engineering

1124
00:40:41,190 --> 00:40:36,800
what would you recommend to do what you

1125
00:40:47,109 --> 00:40:43,349
how about luis you give us a start yeah

1126
00:40:49,270 --> 00:40:47,119
sure yeah all right um i i would so i

1127
00:40:50,790 --> 00:40:49,280
studied mechanical engineering but i

1128
00:40:53,510 --> 00:40:50,800
kind of ended up falling into

1129
00:40:55,990 --> 00:40:53,520
electronics as an intern

1130
00:40:59,109 --> 00:40:56,000
i i worked with the electrical team on

1131
00:41:00,790 --> 00:40:59,119
the mars science laboratory atlo team

1132
00:41:03,750 --> 00:41:00,800
and that kind of

1133
00:41:05,510 --> 00:41:03,760
helped me develop a love for electronics

1134
00:41:06,390 --> 00:41:05,520
so i wish i had studied electrical

1135
00:41:09,109 --> 00:41:06,400
engineering

1136
00:41:10,790 --> 00:41:09,119
um but what i ended up doing is you know

1137
00:41:12,150 --> 00:41:10,800
the the mechanical engineering and

1138
00:41:14,390 --> 00:41:12,160

electrical engineering the math is all

1139
00:41:16,230 --> 00:41:14,400
the same um the formulas change a little

1140
00:41:18,309 --> 00:41:16,240
bit but overall the mathematical

1141
00:41:20,790 --> 00:41:18,319
principles are the same and so it's

1142
00:41:21,750 --> 00:41:20,800
really about just um you know taking the

1143
00:41:23,670 --> 00:41:21,760
time

1144
00:41:25,109 --> 00:41:23,680
and the great thing here at jpl is we

1145
00:41:27,510 --> 00:41:25,119
have you know some of the subject matter

1146
00:41:29,589 --> 00:41:27,520
experts you know of all around the world

1147
00:41:31,190 --> 00:41:29,599
that you can go and ask about these

1148
00:41:32,950 --> 00:41:31,200
questions about electronics right i

1149
00:41:35,030 --> 00:41:32,960
could go talk to someone who's an expert

1150
00:41:36,550 --> 00:41:35,040
and feel the field effect transistors

1151
00:41:38,630 --> 00:41:36,560
right if i when i was learning what a

1152
00:41:40,470 --> 00:41:38,640
phet was um and i could you know they

1153
00:41:42,470 --> 00:41:40,480
could talk to me in detail about all

1154
00:41:44,630 --> 00:41:42,480
these different things and uh it just

1155
00:41:46,230 --> 00:41:44,640
you know further kind of uh helped me

1156
00:41:48,230 --> 00:41:46,240
learn about electronics even though i

1157
00:41:49,829 --> 00:41:48,240
didn't study electrical engineering but

1158
00:41:51,670 --> 00:41:49,839
i would have studied electrical i wish i

1159
00:41:53,589 --> 00:41:51,680
had um but

1160
00:41:57,670 --> 00:41:53,599
hey

1161
00:42:01,750 --> 00:41:59,750
yeah and i and building off of that

1162
00:42:04,230 --> 00:42:01,760
always learning on the job

1163
00:42:05,750 --> 00:42:04,240

my personal opinion i think

1164
00:42:07,349 --> 00:42:05,760
engineering school teaches you how to

1165
00:42:10,390 --> 00:42:07,359
think like an engineer

1166
00:42:13,190 --> 00:42:10,400
and the discipline is really

1167
00:42:15,190 --> 00:42:13,200
an extra right it's based on your list

1168
00:42:17,829 --> 00:42:15,200
and do i want to focus more

1169
00:42:19,750 --> 00:42:17,839
on aerospace or do i wanna with a

1170
00:42:21,430 --> 00:42:19,760
mechanical major we learn a little bit

1171
00:42:23,510 --> 00:42:21,440
of electrical we learn a little bit of

1172
00:42:26,390 --> 00:42:23,520
aerospace and

1173
00:42:29,030 --> 00:42:26,400
you have um a lot more versatility that

1174
00:42:30,710 --> 00:42:29,040
way but at the same time too

1175
00:42:33,190 --> 00:42:30,720
getting a degree in engineering really

1176
00:42:35,670 --> 00:42:33,200
teaches you how to break things down to

1177
00:42:37,349 --> 00:42:35,680
problem solve in a logical manner and it

1178
00:42:39,030 --> 00:42:37,359
gives you a lot of the fundamentals with

1179
00:42:41,990 --> 00:42:39,040
your calculus like what luis was saying

1180
00:42:44,470 --> 00:42:42,000
with your physics no matter which flavor

1181
00:42:46,390 --> 00:42:44,480
of engineering you choose to do

1182
00:42:49,270 --> 00:42:46,400
um so i don't think that there's one

1183
00:42:51,030 --> 00:42:49,280
specific major that is the right major

1184
00:42:52,470 --> 00:42:51,040
to do this job

1185
00:42:54,470 --> 00:42:52,480
i think it's really what you make of it

1186
00:42:56,550 --> 00:42:54,480
and what your interests are but any of

1187
00:42:59,030 --> 00:42:56,560
those majors will give you the right

1188
00:43:01,430 --> 00:42:59,040

skill set to logically problem solve and

1189
00:43:03,109 --> 00:43:01,440
break things down into the fundamentals

1190
00:43:05,349 --> 00:43:03,119
right where all of them you learn how to

1191
00:43:06,870 --> 00:43:05,359
draw a free body diagram and say okay

1192
00:43:08,550 --> 00:43:06,880
this is where your forces are and this

1193
00:43:10,069 --> 00:43:08,560
is how it's going to react and it's a

1194
00:43:12,470 --> 00:43:10,079
lot of physics

1195
00:43:14,150 --> 00:43:12,480
and and math that all come together and

1196
00:43:16,470 --> 00:43:14,160
teach you how to think

1197
00:43:18,470 --> 00:43:16,480
and that problem solving is really what

1198
00:43:20,390 --> 00:43:18,480
makes you successful on the floor and

1199
00:43:22,150 --> 00:43:20,400
you get that experience working with

1200
00:43:23,430 --> 00:43:22,160
hardware whether it's testing hardware

1201
00:43:25,109 --> 00:43:23,440
whether it's building hardware whether

1202
00:43:27,750 --> 00:43:25,119
it's designing hardware whether it's

1203
00:43:29,990 --> 00:43:27,760
accommodating hardware right you build

1204
00:43:31,910 --> 00:43:30,000
that experience on the job to do the

1205
00:43:34,069 --> 00:43:31,920
specific

1206
00:43:36,309 --> 00:43:34,079
um tasks that you're tasked with doing

1207
00:43:38,710 --> 00:43:36,319
because no real major is going to train

1208
00:43:42,069 --> 00:43:38,720
you how to how to do how to out low

1209
00:43:45,670 --> 00:43:43,510
that's some great advice that you're

1210
00:43:47,109 --> 00:43:45,680
passing on to the next generation and

1211
00:43:48,710 --> 00:43:47,119
before we end this evening i know we

1212
00:43:50,390 --> 00:43:48,720
said that was our last question but

1213
00:43:52,150 --> 00:43:50,400

michelle and luis wanted to share some

1214
00:43:53,190 --> 00:43:52,160
final words with our audience so

1215
00:43:55,829 --> 00:43:53,200
michelle i'm going to throw it back to

1216
00:43:57,910 --> 00:43:55,839
you why don't you start for us

1217
00:44:01,349 --> 00:43:57,920
yeah so actually building a lot on on

1218
00:44:03,670 --> 00:44:01,359
that conversation right i i came from

1219
00:44:07,349 --> 00:44:03,680
i'm very local southern california born

1220
00:44:09,430 --> 00:44:07,359
and raised i've driven by jpl time and

1221
00:44:11,589 --> 00:44:09,440
time again growing up on my way to other

1222
00:44:12,630 --> 00:44:11,599
socal destinations

1223
00:44:13,589 --> 00:44:12,640
and

1224
00:44:15,349 --> 00:44:13,599
when i

1225
00:44:16,470 --> 00:44:15,359
started working at jpl i'm going to be

1226
00:44:19,030 --> 00:44:16,480
honest with you this isn't something i

1227
00:44:21,510 --> 00:44:19,040
share often but i had what we call the

1228
00:44:23,829 --> 00:44:21,520
imposter syndrome right we have subject

1229
00:44:25,109 --> 00:44:23,839
matter experts from all over the world

1230
00:44:27,829 --> 00:44:25,119
we've got like some of the leading

1231
00:44:30,069 --> 00:44:27,839
tribologists who specialize in bearings

1232
00:44:32,470 --> 00:44:30,079
that were in the same mechanisms group

1233
00:44:33,990 --> 00:44:32,480
that i was in and i said what am i doing

1234
00:44:35,510 --> 00:44:34,000
here one day they're gonna they're gonna

1235
00:44:37,589 --> 00:44:35,520
find out they're gonna catch they're

1236
00:44:38,550 --> 00:44:37,599
going to catch on that i just i'm a

1237
00:44:40,309 --> 00:44:38,560
fluke

1238
00:44:42,870 --> 00:44:40,319

and

1239
00:44:44,950 --> 00:44:42,880
my career path has not really been

1240
00:44:48,230 --> 00:44:44,960
wanting to go and be that subject matter

1241
00:44:50,230 --> 00:44:48,240
expert and i found that

1242
00:44:52,550 --> 00:44:50,240
people of all backgrounds have a place

1243
00:44:55,270 --> 00:44:52,560
in aerospace building flight hardware

1244
00:44:57,109 --> 00:44:55,280
whether it's supporting in int whether

1245
00:44:59,589 --> 00:44:57,119
it's designing whether it's building

1246
00:45:01,349 --> 00:44:59,599
facilities and infrastructure or testing

1247
00:45:04,230 --> 00:45:01,359
rocks in the mars yard or doing the

1248
00:45:07,910 --> 00:45:04,240
science i mean it all is so important

1249
00:45:10,870 --> 00:45:07,920
and there's no one path to get there um

1250
00:45:12,950 --> 00:45:10,880
so i really found that niche that hey i

1251
00:45:15,990 --> 00:45:12,960
can play off my skill set of being

1252
00:45:18,150 --> 00:45:16,000
resourceful being a good communicator um

1253
00:45:19,910 --> 00:45:18,160
really wanting to solve problems and

1254
00:45:21,670 --> 00:45:19,920
knowing when i am not the person to

1255
00:45:23,990 --> 00:45:21,680
provide that answer going to find the

1256
00:45:25,670 --> 00:45:24,000
right person to provide that answer and

1257
00:45:26,550 --> 00:45:25,680
that's a skill set that not a lot of

1258
00:45:30,069 --> 00:45:26,560
people

1259
00:45:31,589 --> 00:45:30,079
necessarily have and that's um it's very

1260
00:45:33,990 --> 00:45:31,599
different because i am not a subject

1261
00:45:36,309 --> 00:45:34,000
matter expert i am probably a jack of

1262
00:45:37,910 --> 00:45:36,319
many traits but a master of none and

1263
00:45:40,390 --> 00:45:37,920

that does contrast with a lot of the

1264
00:45:41,990 --> 00:45:40,400
subject matter experts who

1265
00:45:44,069 --> 00:45:42,000
who have the answers but they don't

1266
00:45:44,829 --> 00:45:44,079
always have the answers for everything

1267
00:45:47,910 --> 00:45:44,839
and

1268
00:45:50,309 --> 00:45:47,920
so kind of summarizing all of that the

1269
00:45:51,750 --> 00:45:50,319
biggest takeaway is i i want everyone to

1270
00:45:53,510 --> 00:45:51,760
feel encouraged that if you are

1271
00:45:55,910 --> 00:45:53,520
passionate enough and you want to pursue

1272
00:45:58,150 --> 00:45:55,920
a career in aerospace and you want to do

1273
00:46:01,109 --> 00:45:58,160
atlo or you want to go and design like

1274
00:46:03,109 --> 00:46:01,119
the next rocket there is no one path to

1275
00:46:05,030 --> 00:46:03,119
get there it's really based on your

1276
00:46:06,870 --> 00:46:05,040
experiences it's what you make of it

1277
00:46:09,349 --> 00:46:06,880
it's maintaining that motivation and

1278
00:46:11,030 --> 00:46:09,359
drive and confidence in yourself to

1279
00:46:13,430 --> 00:46:11,040
reach and achieve your goals because if

1280
00:46:15,349 --> 00:46:13,440
you try hard enough like one way or

1281
00:46:16,950 --> 00:46:15,359
another you will you will get there it's

1282
00:46:19,030 --> 00:46:16,960
just it's just maintaining that

1283
00:46:20,950 --> 00:46:19,040
motivation and morale to to accomplish

1284
00:46:22,630 --> 00:46:20,960
those goals

1285
00:46:24,630 --> 00:46:22,640
i certainly feel motivated thank you for

1286
00:46:27,510 --> 00:46:24,640
those words michelle and luisa i want to

1287
00:46:29,510 --> 00:46:27,520
pass it off to you for your final words

1288
00:46:31,589 --> 00:46:29,520

yeah absolutely yeah and and you know i

1289
00:46:33,109 --> 00:46:31,599
was always passionate about airplanes i

1290
00:46:34,790 --> 00:46:33,119
i always wanted to work on airplanes

1291
00:46:37,589 --> 00:46:34,800
growing up my my first level was

1292
00:46:39,750 --> 00:46:37,599
airplanes um and i still i chose

1293
00:46:41,670 --> 00:46:39,760
mechanical engineering um only because

1294
00:46:43,589 --> 00:46:41,680
my dad was a mechanic

1295
00:46:45,750 --> 00:46:43,599
and so i understood mechanisms i

1296
00:46:48,150 --> 00:46:45,760
understood cars and so mechanical

1297
00:46:50,950 --> 00:46:48,160
engineering seemed very natural to me um

1298
00:46:53,670 --> 00:46:50,960
you know i had never thought of a

1299
00:46:54,550 --> 00:46:53,680
electrical engineering as a potential uh

1300
00:46:57,349 --> 00:46:54,560
you know

1301
00:46:59,510 --> 00:46:57,359
career path but um once i got here at

1302
00:47:01,349 --> 00:46:59,520
jpl you know i was just given a lot of

1303
00:47:03,430 --> 00:47:01,359
support and a lot of help to kind of

1304
00:47:04,790 --> 00:47:03,440
develop those skills and so

1305
00:47:06,550 --> 00:47:04,800
what i would say is you know just you

1306
00:47:08,150 --> 00:47:06,560
know keep developing those skills keep

1307
00:47:10,390 --> 00:47:08,160
developing different different skill

1308
00:47:12,069 --> 00:47:10,400
sets them you know at every opportunity

1309
00:47:13,910 --> 00:47:12,079
take the chance to learn anything you

1310
00:47:15,270 --> 00:47:13,920
can because you know any additional

1311
00:47:17,510 --> 00:47:15,280
skill you learn is just another tool

1312
00:47:19,750 --> 00:47:17,520
that you can add to your tool belt um

1313
00:47:21,430 --> 00:47:19,760

you know what i always tell my uh when i

1314
00:47:23,829 --> 00:47:21,440
when i do outreach to kids is you know

1315
00:47:26,390 --> 00:47:23,839
live your life with courage curiosity

1316
00:47:28,069 --> 00:47:26,400
tenacity and a healthy dose of altruism

1317
00:47:29,910 --> 00:47:28,079
you know and if you're doing those four

1318
00:47:31,670 --> 00:47:29,920
things it doesn't matter where you're at

1319
00:47:33,430 --> 00:47:31,680
it doesn't matter what you're doing you

1320
00:47:36,309 --> 00:47:33,440
know you will succeed and the people

1321
00:47:38,790 --> 00:47:36,319
around you will succeed so um yeah those

1322
00:47:40,390 --> 00:47:38,800
would be my parting words

1323
00:47:42,309 --> 00:47:40,400
those are some pretty impactful words

1324
00:47:44,549 --> 00:47:42,319
from both of you so unfortunately that

1325
00:47:46,150 --> 00:47:44,559
is all the time we have for today i want

1326
00:47:48,309 --> 00:47:46,160
to thank our wonderful speakers this

1327
00:47:50,470 --> 00:47:48,319
evening michelle colisey and luis

1328
00:47:53,190 --> 00:47:50,480
dominguez for joining us to discuss

1329
00:47:55,910 --> 00:47:53,200
spacecraft at low also a big thank you

1330
00:47:57,670 --> 00:47:55,920
to our questions co-host brian white and

1331
00:48:00,069 --> 00:47:57,680
everyone working behind the scenes to

1332
00:48:01,589 --> 00:48:00,079
make this possible and to all of you

1333
00:48:03,190 --> 00:48:01,599
watching at home

1334
00:48:05,670 --> 00:48:03,200
thank you so much for taking time to

1335
00:48:07,270 --> 00:48:05,680
join us every month if you missed one or

1336
00:48:09,349 --> 00:48:07,280
would like to revisit any of the von

1337
00:48:12,230 --> 00:48:09,359
carmen talks from the past five years

1338
00:48:13,910 --> 00:48:12,240

they are available on jpl's youtube page

1339
00:48:16,790 --> 00:48:13,920
and please do join us next month for

1340
00:48:18,630 --> 00:48:16,800
curiosity a decade on mars

1341
00:48:20,870 --> 00:48:18,640
where we will dive deeper into what the

1342
00:48:23,430 --> 00:48:20,880
curiosity rover has done in the last 10

1343
00:48:28,150 --> 00:48:23,440
years on mars thanks everyone and have a