1
00:00:04,999 --> 00:00:03,500
how does it feel it feels great hi my

2
00:00:06,619 --> 00:00:05,009
name is Heather bottom and I'm helping

3
00:00:08,330 --> 00:00:06,629
prepare the spacecraft that will fly our

4
00:00:11,419 --> 00:00:08,340
next Mars rover to the Martian surface

5
00:00:13,549 --> 00:00:11,429
so here we have the rover test facility

6
00:00:17,599 --> 00:00:13,559
for the Mars 2020 project so the goal of

7
00:00:19,939 --> 00:00:17,609
Mars 2020 is to collect samples of the

8
00:00:22,340 --> 00:00:19,949
surface of Mars and perform lots of

9
00:00:23,990 --> 00:00:22,350
other exciting experiments there's seven

10
00:00:25,790 --> 00:00:24,000
different instruments on the rover some

11
00:00:28,189 --> 00:00:25,800
of the work that's being done here right

12
00:00:30,109 --> 00:00:28,199
now is integrating the arm and the mast

13
00:00:31,999 --> 00:00:30,119

my role is mostly on the systems

14
00:00:33,830 --> 00:00:32,009
engineering of the launch and cruise

15
00:00:35,990 --> 00:00:33,840
phases of the mission is essentially

16
00:00:37,400 --> 00:00:36,000
getting it to Mars as a systems engineer

17
00:00:38,869 --> 00:00:37,410
you kind of have to put those different

18
00:00:41,090 --> 00:00:38,879
pieces together and make sure that those

19
00:00:43,100 --> 00:00:41,100
pieces all are gonna work you get to

20
00:00:44,569 --> 00:00:43,110
kind of see the bigger picture before

21
00:00:45,650 --> 00:00:44,579
the rover actually flies you have to

22
00:00:47,630 --> 00:00:45,660
make sure that everything works properly

23
00:00:50,119 --> 00:00:47,640
with the flight software and the

24
00:00:52,040 --> 00:00:50,129
hardware so I have a little unique story

25
00:00:54,020 --> 00:00:52,050
I actually ended up becoming a

26
00:00:55,670 --> 00:00:54,030
professional dancer in New York and I

27
00:00:57,380 --> 00:00:55,680
really like lived that out so its

28
00:00:59,060 --> 00:00:57,390
fullest and where all the makeup the

29
00:01:00,650 --> 00:00:59,070
rhinestones and things but for some

30
00:01:02,510 --> 00:01:00,660
reason I I always knew I was going to

31
00:01:05,030 --> 00:01:02,520
come back to this kind of curiosity that

32
00:01:06,740 --> 00:01:05,040
I've always had with space there's some

33
00:01:09,440 --> 00:01:06,750
of that creativity here too

34
00:01:11,179 --> 00:01:09,450
sometimes I feel like we're kind of like

35
00:01:12,859 --> 00:01:11,189
the stagehands in this big production

36
00:01:14,270 --> 00:01:12,869
for the rover it's bringing together a

37
00:01:15,620 --> 00:01:14,280
bunch of people it's making sure that

38
00:01:17,240 --> 00:01:15,630

the hardware works and it's kind of

39
00:01:19,370 --> 00:01:17,250
similar to a performance or like on

40
00:01:24,670 --> 00:01:19,380
launch day it'll be the opening night

41
00:01:30,230 --> 00:01:28,160
hi I'm Kevin Weaver with NASA's Jet

42
00:01:33,440 --> 00:01:30,240
Propulsion Laboratory in Southern

43
00:01:35,990 --> 00:01:33,450
California JPL is where the Mars 2020

44
00:01:39,050 --> 00:01:36,000
mission and perseverance Rover are

45
00:01:42,290 --> 00:01:39,060
managed getting to Mars is a test of

46
00:01:45,290 --> 00:01:42,300
perseverance in itself there are so many

47
00:01:47,420 --> 00:01:45,300
incredible stories from the thousands of

48
00:01:49,850 --> 00:01:47,430
people who are part of the mission today

49
00:01:51,020 --> 00:01:49,860
we're with one of the many faces behind

50
00:01:54,200 --> 00:01:51,030
the spacecraft

51
00:01:57,080 --> 00:01:54,210
Heather bottom is a systems engineer for

52
00:01:58,969 --> 00:01:57,090
the Mars 2020 mission which means she is

53
00:02:00,230 --> 00:01:58,979
making sure all the pieces work together

54
00:02:02,240 --> 00:02:00,240
on the spacecraft

55
00:02:03,980 --> 00:02:02,250
Heather's journey to testing Rockets

56
00:02:06,320 --> 00:02:03,990
actually started with a career in the

57
00:02:08,540 --> 00:02:06,330
arts including dancing for the Rockettes

58
00:02:11,480 --> 00:02:08,550
she joins us from her home today to

59
00:02:13,370 --> 00:02:11,490
answer questions and if you have any

60
00:02:14,930 --> 00:02:13,380
questions you'd like to ask you can

61
00:02:18,290 --> 00:02:14,940
leave them right here in the YouTube

62
00:02:21,380 --> 00:02:18,300
chat or post them to social media using

63
00:02:23,330 --> 00:02:21,390

the hashtag ask NASA now if you're on

64
00:02:25,250 --> 00:02:23,340
youtube and can't see the questions or

65
00:02:27,199 --> 00:02:25,260
the chat room yet just refresh your

66
00:02:30,940 --> 00:02:27,209
browser and it should all be there and

67
00:02:33,800 --> 00:02:30,950
Heather thanks for talking to us today

68
00:02:34,660 --> 00:02:33,810
Thanks thanks for having me yeah this'll

69
00:02:37,910 --> 00:02:34,670
be great

70
00:02:40,310 --> 00:02:37,920
I'm great so to start off as a systems

71
00:02:42,770 --> 00:02:40,320
engineer your focus is on the bigger

72
00:02:46,570 --> 00:02:42,780
picture can you describe what you're

73
00:02:52,130 --> 00:02:49,580
absolutely so I'm one of the launch

74
00:02:55,280 --> 00:02:52,140
systems engineers so we're preparing the

75
00:02:58,250 --> 00:02:55,290
vehicle for launch day on hopefully on

76
00:03:00,020 --> 00:02:58,260
July 17th which means preparing all of

77
00:03:01,400 --> 00:03:00,030
the different files and sequences that

78
00:03:04,370 --> 00:03:01,410
you need to have onboard for the

79
00:03:06,170 --> 00:03:04,380
spacecraft in my it means preparing the

80
00:03:08,680 --> 00:03:06,180
procedures that you're going to need for

81
00:03:11,060 --> 00:03:08,690
launch day as well as after launch day

82
00:03:13,280 --> 00:03:11,070
so there's a plenty of things that are

83
00:03:13,940 --> 00:03:13,290
going on in preparation for launch but

84
00:03:16,030 --> 00:03:13,950
in parallel

85
00:03:18,920 --> 00:03:16,040
we're also orchestrating a number of

86
00:03:21,320 --> 00:03:18,930
system level tests scenario tests day in

87
00:03:23,390 --> 00:03:21,330
the life sort of scenarios where we

88
00:03:25,400 --> 00:03:23,400

bring all three different stages of the

89
00:03:27,860 --> 00:03:25,410
vehicle together so we have the crew

90
00:03:29,570 --> 00:03:27,870
stage that's going to get us to Mars the

91
00:03:31,150 --> 00:03:29,580
defense stage that helps us get to the

92
00:03:34,000 --> 00:03:31,160
surface of Mars I'm

93
00:03:35,590 --> 00:03:34,010
the rover which obviously is performing

94
00:03:37,930 --> 00:03:35,600
all the science that we wanted to on the

95
00:03:40,360 --> 00:03:37,940
surface so by integrating all three of

96
00:03:42,100 --> 00:03:40,370
those stages together we perform the

97
00:03:44,050 --> 00:03:42,110
scenario tests where we simulate the

98
00:03:46,780 --> 00:03:44,060
actual flight hardware with the flight

99
00:03:48,400 --> 00:03:46,790
software launching traveling through

100
00:03:50,830 --> 00:03:48,410
space and then landing on Mars and

101
00:03:52,300 --> 00:03:50,840
performing some surface operation so for

102
00:03:55,090 --> 00:03:52,310
the last few years we've been really

103
00:03:57,430 --> 00:03:55,100
focused on the series of tests and

104
00:03:58,990 --> 00:03:57,440
really the unit under test there has

105
00:04:00,910 --> 00:03:59,000
been the flight hardware and a flight

106
00:04:04,060 --> 00:04:00,920
software and most recently we've started

107
00:04:06,040 --> 00:04:04,070
bringing in now the operators so people

108
00:04:09,130 --> 00:04:06,050
like myself and the flight team the

109
00:04:11,860 --> 00:04:09,140
operating team who then come in and

110
00:04:15,220 --> 00:04:11,870
we're now tested and so we go through a

111
00:04:20,140 --> 00:04:15,230
series of tests for launch I'm in regard

112
00:04:22,780 --> 00:04:20,150
to oh we seem to have lost a connection

113
00:04:25,300 --> 00:04:22,790

a little bit so I will kind of ask it

114
00:04:26,770 --> 00:04:25,310
again and see if you can hear me what

115
00:04:31,690 --> 00:04:26,780
was that last part that you said again

116
00:04:33,700 --> 00:04:31,700
oh um what we so yeah so we're going

117
00:04:39,610 --> 00:04:33,710
through a series of scenario tests did

118
00:04:41,920 --> 00:04:39,620
you get that part maybe um yeah so the

119
00:04:44,170 --> 00:04:41,930
scenario places that we perform simulate

120
00:04:46,060 --> 00:04:44,180
the vehicle launching traveling through

121
00:04:49,600 --> 00:04:46,070
space and then landing on the surface of

122
00:04:51,850 --> 00:04:49,610
Mars and then obviously performing some

123
00:04:54,010 --> 00:04:51,860
surface activities as well so once we go

124
00:04:56,620 --> 00:04:54,020
through those series of tests now we've

125
00:04:58,480 --> 00:04:56,630
added in the operators themselves like

126
00:05:00,670 --> 00:04:58,490
myself and the rest of the flight team

127
00:05:02,740 --> 00:05:00,680
the operating team and so we're working

128
00:05:05,170 --> 00:05:02,750
now on a series of tests where it

129
00:05:06,970 --> 00:05:05,180
includes the operators as well and we'll

130
00:05:12,090 --> 00:05:06,980
continue doing these tests as we get

131
00:05:15,340 --> 00:05:12,100
towards the launch window okay great and

132
00:05:19,180 --> 00:05:15,350
what I was gonna ask oh do you even keep

133
00:05:23,530 --> 00:05:19,190
the test going after launch oh yes

134
00:05:25,180 --> 00:05:23,540
absolutely um so the launch team really

135
00:05:27,610 --> 00:05:25,190
obviously our cutoff date is gonna be

136
00:05:30,070 --> 00:05:27,620
launch but we have six months until we

137
00:05:32,290 --> 00:05:30,080
get to Mars so there's a whole series of

138
00:05:34,600 --> 00:05:32,300

entry descent and landing testing that

139
00:05:36,520 --> 00:05:34,610
happens over those six months also

140
00:05:38,590 --> 00:05:36,530
including the operators making sure that

141
00:05:40,810 --> 00:05:38,600
the operators are all ready to support

142
00:05:43,480 --> 00:05:40,820
and then of course there is the surface

143
00:05:44,620 --> 00:05:43,490
series of tests that are still being

144
00:05:46,630 --> 00:05:44,630
performed during those

145
00:05:48,640 --> 00:05:46,640
six months and so part of the planning

146
00:05:50,410 --> 00:05:48,650
process is identifying what do we

147
00:05:51,880 --> 00:05:50,420
absolutely have to do before we launch

148
00:05:54,580 --> 00:05:51,890
what's the bare minimum and then what

149
00:05:56,110 --> 00:05:54,590
can we push off for those six months to

150
00:06:01,390 --> 00:05:56,120
buy us a little bit of time for some of

151
00:06:04,090 --> 00:06:01,400
those preparations great and then we

152
00:06:06,640 --> 00:06:04,100
kind of got into the name perseverance

153
00:06:08,350 --> 00:06:06,650
and all the testing that really lives up

154
00:06:13,110 --> 00:06:08,360
to its name what are your personal

155
00:06:15,400 --> 00:06:13,120
thought a name oh gosh um well

156
00:06:19,030 --> 00:06:15,410
perseverance is so much more than a name

157
00:06:22,360 --> 00:06:19,040
I guess for the launch team we've really

158
00:06:22,870 --> 00:06:22,370
felt this this drive toward the launch

159
00:06:25,510 --> 00:06:22,880
window

160
00:06:28,570 --> 00:06:25,520
July 17th is when it opens and might

161
00:06:30,220 --> 00:06:28,580
last until about the end of August and

162
00:06:31,570 --> 00:06:30,230
if you don't make it in that launch

163
00:06:33,400 --> 00:06:31,580

window if you don't launch within that

164
00:06:36,130 --> 00:06:33,410
time we'll have to wait another two

165
00:06:38,530 --> 00:06:36,140
years before Earth and Mars alignment

166
00:06:40,900 --> 00:06:38,540
will be appropriate for us to actually

167
00:06:43,000 --> 00:06:40,910
get to Mars so I think our team is

168
00:06:46,360 --> 00:06:43,010
definitely persevering toward that that

169
00:06:49,780 --> 00:06:46,370
deadline and certainly I feel the

170
00:06:51,820 --> 00:06:49,790
pressure there but then you know

171
00:06:55,120 --> 00:06:51,830
perseverance is held in so many other

172
00:06:59,170 --> 00:06:55,130
ways for our team and any other teams as

173
00:07:01,480 --> 00:06:59,180
well that's great and another thing I

174
00:07:04,270 --> 00:07:01,490
really wanted to ask you about is your

175
00:07:07,060 --> 00:07:04,280
career being a mix of art and science

176
00:07:11,230 --> 00:07:07,070
can you talk about your journey and how

177
00:07:12,040 --> 00:07:11,240
you got to be here at JPL yeah

178
00:07:14,530 --> 00:07:12,050
absolutely

179
00:07:17,170 --> 00:07:14,540
um so ever since I was little I always

180
00:07:18,640 --> 00:07:17,180
enjoyed dancing and performing so I've

181
00:07:20,920 --> 00:07:18,650
always kind of kept that with me as

182
00:07:22,990 --> 00:07:20,930
times gone on but when I was younger I

183
00:07:26,530 --> 00:07:23,000
found a real love for astronomy

184
00:07:29,920 --> 00:07:26,540
so I major in college undergrad in

185
00:07:31,540 --> 00:07:29,930
astronomy and then after college there

186
00:07:33,550 --> 00:07:31,550
actually excuse me through college I

187
00:07:35,530 --> 00:07:33,560
took an internship with the NASA Ames

188
00:07:37,630 --> 00:07:35,540

Research Center it was called the NASA

189
00:07:40,450 --> 00:07:37,640
Academy at the time not sure if it's

190
00:07:42,879 --> 00:07:40,460
still called that and through the NASA

191
00:07:44,320 --> 00:07:42,889
it really opened up my eyes not just to

192
00:07:47,529 --> 00:07:44,330
astronomy but to this whole space

193
00:07:48,939 --> 00:07:47,539
industry not just NASA but that also the

194
00:07:51,249 --> 00:07:48,949
commercial space industry that's

195
00:07:53,860 --> 00:07:51,259
happening right now but SpaceX sons of

196
00:07:55,749 --> 00:07:53,870
origin so do that internship it showed

197
00:07:57,820 --> 00:07:55,759
me there was so much more and so I told

198
00:07:59,559 --> 00:07:57,830
myself at the time I knew no matter how

199
00:08:02,140 --> 00:07:59,569
much dance I pursued I would always come

200
00:08:06,700 --> 00:08:02,150
back to space and I think I think I say

201
00:08:09,100 --> 00:08:06,710
that in the video too but yeah so you

202
00:08:12,700 --> 00:08:09,110
know so I went and pursued dance um I

203
00:08:14,529 --> 00:08:12,710
was when I was indeed or really hard so

204
00:08:17,170 --> 00:08:14,539
I did the Rockettes and I did a show

205
00:08:18,700 --> 00:08:17,180
called A Chorus Line at the time and I

206
00:08:21,610 --> 00:08:18,710
hit a point where I said okay it's time

207
00:08:24,820 --> 00:08:21,620
to go back so I had learned about

208
00:08:27,460 --> 00:08:24,830
engineering so I went back to school I

209
00:08:31,629 --> 00:08:27,470
Caltech in Pasadena for aerospace

210
00:08:34,750 --> 00:08:31,639
engineering and I started to learn that

211
00:08:37,570 --> 00:08:34,760
I really loved this big picture idea and

212
00:08:39,909 --> 00:08:37,580
I took a job in systems engineering at

213
00:08:41,740 --> 00:08:39,919

SpaceX and so when I was at SpaceX I

214
00:08:43,300 --> 00:08:41,750
learned about systems engineering and

215
00:08:46,060 --> 00:08:43,310
how important that is to the spacecraft

216
00:08:47,500 --> 00:08:46,070
into the whole mission it felt like it

217
00:08:49,199 --> 00:08:47,510
really hit home for me that was

218
00:08:52,510 --> 00:08:49,209
something that I could really relate to

219
00:08:54,940 --> 00:08:52,520
and so then do friends and resume

220
00:08:57,220 --> 00:08:54,950
passing around things I ended up by JPL

221
00:09:01,720 --> 00:08:57,230
eventually but those are kind of the

222
00:09:03,550 --> 00:09:01,730
journey of how I got there and for

223
00:09:06,160 --> 00:09:03,560
anyone watching who really has a passion

224
00:09:08,050 --> 00:09:06,170
for science and art like you do what

225
00:09:09,699 --> 00:09:08,060
advice would you give them when they're

226
00:09:13,900 --> 00:09:09,709
kind of trying to decide their career

227
00:09:17,470 --> 00:09:13,910
path and how to balance both oh gosh um

228
00:09:21,550 --> 00:09:17,480
so I guess to never like give up on

229
00:09:23,620 --> 00:09:21,560
either I think what I found is I had to

230
00:09:26,440 --> 00:09:23,630
maintain and find a balance as I've

231
00:09:28,420 --> 00:09:26,450
gotten older so every time I find that

232
00:09:31,240 --> 00:09:28,430
I've gone without dance or singing for a

233
00:09:34,269 --> 00:09:31,250
while I kind of get sad and I need to

234
00:09:35,560 --> 00:09:34,279
find a dance class to take or I'll sing

235
00:09:37,690 --> 00:09:35,570
at home with my husband there's

236
00:09:40,480 --> 00:09:37,700
something like that and equally when I

237
00:09:43,360 --> 00:09:40,490
had pursued dance so hard for so long I

238
00:09:45,040 --> 00:09:43,370

really found that I missed research and

239
00:09:48,100 --> 00:09:45,050
I missed learning about space and my

240
00:09:48,650 --> 00:09:48,110
passion for space and so as I've gotten

241
00:09:50,119 --> 00:09:48,660
older

242
00:09:51,590 --> 00:09:50,129
you can't let one of the other really

243
00:09:54,559 --> 00:09:51,600
take over and so you really have to

244
00:09:58,400 --> 00:09:54,569
maintain that balance so just never give

245
00:10:00,319 --> 00:09:58,410
up on that and I guess there's something

246
00:10:03,680 --> 00:10:00,329
else I was gonna say along his lines but

247
00:10:05,360 --> 00:10:03,690
what we'll get back to anyway all right

248
00:10:07,040 --> 00:10:05,370
because those were all my questions and

249
00:10:09,079 --> 00:10:07,050
if you get back to and remember just let

250
00:10:12,139 --> 00:10:09,089
me know I'm gonna get now to the ask

251
00:10:12,949 --> 00:10:12,149
NASA questions and see what people have

252
00:10:15,490 --> 00:10:12,959
to say so

253
00:10:18,350 --> 00:10:15,500
Martian Manisha on Twitter asks how is

254
00:10:23,329 --> 00:10:18,360
engineering for Mars different from

255
00:10:25,819 --> 00:10:23,339
engineering for Earth oh gosh um so this

256
00:10:28,220 --> 00:10:25,829
is a fun question I recently had some

257
00:10:30,829 --> 00:10:28,230
discussions raised some astronomers so

258
00:10:32,720 --> 00:10:30,839
astronomers have tells gotiya better on

259
00:10:34,579 --> 00:10:32,730
the ground and you can access them at

260
00:10:35,929 --> 00:10:34,589
any time and as I was talking to these

261
00:10:37,819 --> 00:10:35,939
astronomers that are saying yeah you

262
00:10:39,170 --> 00:10:37,829
know if we run into issues you just go

263
00:10:41,150 --> 00:10:39,180

up to the telescope any fix the

264
00:10:42,920 --> 00:10:41,160
telescope I'm thinking to myself it

265
00:10:45,559 --> 00:10:42,930
actually took me some time to realize oh

266
00:10:47,179 --> 00:10:45,569
you can just go touch the hardware and

267
00:10:49,280 --> 00:10:47,189
fix it like if you have a problem you

268
00:10:51,170 --> 00:10:49,290
know that's part of your your project

269
00:10:52,850 --> 00:10:51,180
that's just how it works like when you

270
00:10:54,379 --> 00:10:52,860
can send things up to space you you

271
00:10:56,329 --> 00:10:54,389
don't get to touch it anymore once it's

272
00:10:59,210 --> 00:10:56,339
up there so if you have to consider all

273
00:11:00,980 --> 00:10:59,220
the different anomalies and hardware

274
00:11:02,660 --> 00:11:00,990
issues that you could run into before

275
00:11:04,009 --> 00:11:02,670
you send those things up into space and

276
00:11:06,290 --> 00:11:04,019
that's part of this whole test campaign

277
00:11:08,300 --> 00:11:06,300
that we go through and so there's I

278
00:11:10,639 --> 00:11:08,310
think that distinct difference in your

279
00:11:12,679 --> 00:11:10,649
prepping and your planning and your

280
00:11:14,809 --> 00:11:12,689
preparation to make sure that you

281
00:11:16,309 --> 00:11:14,819
include consideration of the fact you

282
00:11:19,309 --> 00:11:16,319
won't be able to touch it anymore

283
00:11:21,259 --> 00:11:19,319
once it gets up there so that means you

284
00:11:24,160 --> 00:11:21,269
almost have to think of every single

285
00:11:28,309 --> 00:11:24,170
thing that could go wrong correct

286
00:11:30,470 --> 00:11:28,319
yeah they I guess the term I've heard

287
00:11:33,559 --> 00:11:30,480
passed around is unknown unknowns so

288
00:11:34,999 --> 00:11:33,569

there's always this small bit that you

289
00:11:37,519 --> 00:11:35,009
keep in the back of your mind with gosh

290
00:11:38,840 --> 00:11:37,529
there are certainly many unknown

291
00:11:42,290 --> 00:11:38,850
unknowns that we haven't thought about

292
00:11:44,059 --> 00:11:42,300
but yes as part of our team for every

293
00:11:45,769 --> 00:11:44,069
agents we're trying to figure out any

294
00:11:47,780 --> 00:11:45,779
different thing we can come up with and

295
00:11:50,420 --> 00:11:47,790
that's part of some of the testing that

296
00:11:53,530 --> 00:11:50,430
we're doing and if certainly if

297
00:11:56,360 --> 00:11:53,540
something does go wrong up in space and

298
00:11:58,759 --> 00:11:56,370
the vehicle doesn't autonomously react

299
00:11:59,660 --> 00:11:58,769
to it then you do have glad operators

300
00:12:02,600 --> 00:11:59,670
come in

301
00:12:04,400 --> 00:12:02,610
command the vehicle and try to get it

302
00:12:07,090 --> 00:12:04,410
back in the state that you at least a

303
00:12:10,040 --> 00:12:07,100
healthy state to get you to Mars

304
00:12:12,320 --> 00:12:10,050
recently in one of our anomalous

305
00:12:15,890 --> 00:12:12,330
operations test that just completed it

306
00:12:18,050 --> 00:12:15,900
was a pretty intense 48 hours we weren't

307
00:12:20,450 --> 00:12:18,060
able to even command the vehicle and so

308
00:12:22,160 --> 00:12:20,460
we had to think through the situation of

309
00:12:25,540 --> 00:12:22,170
what you would do and how you would fix

310
00:12:28,010 --> 00:12:25,550
it and so we went through a series of

311
00:12:29,990 --> 00:12:28,020
differents recoveries that we could do

312
00:12:33,680 --> 00:12:30,000
in order to commander me we eventually

313
00:12:36,650 --> 00:12:33,690

got through it someone and I actually

314
00:12:39,710 --> 00:12:36,660
have another one from Florentin sitters

315
00:12:41,630 --> 00:12:39,720
on YouTube who asks kind of how does the

316
00:12:44,450 --> 00:12:41,640
team decide between the scientific

317
00:12:46,250 --> 00:12:44,460
benefits of certain features compared to

318
00:12:50,630 --> 00:12:46,260
the challenges these pose from an

319
00:12:52,880 --> 00:12:50,640
engineering standpoint that's a really

320
00:13:06,200 --> 00:12:52,890
great question I'm sorry I have a

321
00:13:08,630 --> 00:13:06,210
chicken here some part yeah so it's

322
00:13:10,910 --> 00:13:08,640
definitely a trade so with systems

323
00:13:12,350 --> 00:13:10,920
engineering one of those interesting

324
00:13:14,350 --> 00:13:12,360
parts I don't think people know about

325
00:13:16,910 --> 00:13:14,360
when they sign up for the job level but

326
00:13:20,060 --> 00:13:16,920
you're not just an engineer but you kind

327
00:13:22,370 --> 00:13:20,070
of become a bit of a negotiator so you

328
00:13:24,260 --> 00:13:22,380
have to really understand both sides of

329
00:13:27,530 --> 00:13:24,270
the argument and being able to consider

330
00:13:30,350 --> 00:13:27,540
the risks for both of the trades so that

331
00:13:32,870 --> 00:13:30,360
you can come up with not the 100%

332
00:13:35,480 --> 00:13:32,880
solution but maybe the best solution you

333
00:13:38,510 --> 00:13:35,490
can come up with at the time so I think

334
00:13:40,670 --> 00:13:38,520
a lot of engineers didn't think in like

335
00:13:42,440 --> 00:13:40,680
a black and white space but as a systems

336
00:13:45,320 --> 00:13:42,450
engineer I feel like I'm constantly in a

337
00:13:47,330 --> 00:13:45,330
gray space when trying to understand how

338
00:13:49,820 --> 00:13:47,340

great this is how black need to be a

339
00:13:52,280 --> 00:13:49,830
white we need to be and then you know

340
00:13:54,470 --> 00:13:52,290
talking in depth to these experts to

341
00:13:56,330 --> 00:13:54,480
really know to really know what they

342
00:13:58,220 --> 00:13:56,340
know what to understand what I don't

343
00:14:00,680 --> 00:13:58,230
know because obviously there's plenty I

344
00:14:02,000 --> 00:14:00,690
don't know and and to be able to get to

345
00:14:05,780 --> 00:14:02,010
a place where you can come up with the

346
00:14:08,530 --> 00:14:05,790
best solution for the mission and then I

347
00:14:10,090 --> 00:14:08,540
have another question from Ahmad Homer

348
00:14:12,550 --> 00:14:10,100
I don't know if you know this but how

349
00:14:17,980 --> 00:14:12,560
long do we expect perseverance to last

350
00:14:20,710 --> 00:14:17,990
on Mars oh gosh I don't want to get it

351
00:14:23,340 --> 00:14:20,720
wrong I think it's about one Martian

352
00:14:26,400 --> 00:14:23,350
year which is equivalent to about a year

353
00:14:29,710 --> 00:14:26,410
unlike a handful of months here on earth

354
00:14:31,120 --> 00:14:29,720
something like that but I'm not always

355
00:14:35,350 --> 00:14:31,130
there this team so I don't know the

356
00:14:37,120 --> 00:14:35,360
details about the way so am i you can

357
00:14:39,520 --> 00:14:37,130
also ask that question to ask NASA

358
00:14:43,180 --> 00:14:39,530
persevere or we can get back to you with

359
00:14:45,010 --> 00:14:43,190
an answer on that and he also wants to

360
00:14:50,890 --> 00:14:45,020
know is there any artificial

361
00:14:54,220 --> 00:14:50,900
intelligence on perseverance well so

362
00:14:55,750 --> 00:14:54,230
anyway I think you defined in many

363
00:14:57,790 --> 00:14:55,760

different ways I think one of the

364
00:15:01,120 --> 00:14:57,800
coolest things about this Rover is that

365
00:15:05,380 --> 00:15:01,130
it has an ability to navigate with a

366
00:15:07,720 --> 00:15:05,390
better time escape abilities than the

367
00:15:10,000 --> 00:15:07,730
previous Rovers and curiosity so it's

368
00:15:12,310 --> 00:15:10,010
able to identify different rocks and

369
00:15:15,280 --> 00:15:12,320
move around those rocks that sort of

370
00:15:18,130 --> 00:15:15,290
thing I think that's like the biggest

371
00:15:21,670 --> 00:15:18,140
improvement to AI that we have on the

372
00:15:23,500 --> 00:15:21,680
beautiful for 2020 compared to curiosity

373
00:15:25,450 --> 00:15:23,510
but there's certainly a lot of things

374
00:15:28,630 --> 00:15:25,460
that we've developed a high-rise for all

375
00:15:31,960 --> 00:15:28,640
the Rovers but I would say it depends on

376
00:15:34,960 --> 00:15:31,970
your definition I think a little bit and

377
00:15:37,240 --> 00:15:34,970
another thing that would be new on here

378
00:15:39,460 --> 00:15:37,250
Fletcher on YouTube asks how do you

379
00:15:41,410 --> 00:15:39,470
select the cameras and their angles for

380
00:15:46,420 --> 00:15:41,420
the rover and is a difference for

381
00:15:47,350 --> 00:15:46,430
science versus engineering cameras yeah

382
00:15:49,300 --> 00:15:47,360
absolutely

383
00:15:51,900 --> 00:15:49,310
there are different engineering cameras

384
00:15:53,400 --> 00:15:51,910
I'm dedicated strictly to engineering

385
00:15:55,810 --> 00:15:53,410
hazards

386
00:15:59,680 --> 00:15:55,820
they're called bajas cams on the rover

387
00:16:02,050 --> 00:15:59,690
and then the yet the math comes as well

388
00:16:03,520 --> 00:16:02,060

I will obligation camera and then each

389
00:16:04,660 --> 00:16:03,530
of the instruments not each of the

390
00:16:07,390 --> 00:16:04,670
instruments but many of the instruments

391
00:16:09,730 --> 00:16:07,400
have cameras themselves that are higher

392
00:16:12,160 --> 00:16:09,740
resolution and those sorts of things but

393
00:16:14,080 --> 00:16:12,170
you need to consider the different

394
00:16:18,280 --> 00:16:14,090
resources that those cameras are taking

395
00:16:22,840 --> 00:16:18,290
up onboard so power data

396
00:16:24,550 --> 00:16:22,850
the thermal anything like that just to

397
00:16:26,530 --> 00:16:24,560
consider how much fam that those things

398
00:16:29,050 --> 00:16:26,540
are taking up and so again it becomes a

399
00:16:30,639 --> 00:16:29,060
trade between while which science

400
00:16:31,960 --> 00:16:30,649
objectives are more important to make

401
00:16:34,480 --> 00:16:31,970
sure that we're not in a hazardous

402
00:16:36,040 --> 00:16:34,490
situation with the roller but the

403
00:16:38,860 --> 00:16:36,050
different in terms of the different

404
00:16:41,139 --> 00:16:38,870
angles there are designs so that there

405
00:16:44,129 --> 00:16:41,149
for science specifically or for

406
00:16:48,220 --> 00:16:44,139
engineering purposes specifically and

407
00:16:51,160 --> 00:16:48,230
then give you my toe asks how do you

408
00:16:54,160 --> 00:16:51,170
protect the circuit boards from flips

409
00:16:58,780 --> 00:16:54,170
due to radiation from bit flips due to

410
00:17:02,829 --> 00:16:58,790
radiation I probably not the expert on

411
00:17:05,919 --> 00:17:02,839
on radiation protection but I do know

412
00:17:09,939 --> 00:17:05,929
it's on board so again we'll defer that

413
00:17:11,530 --> 00:17:09,949

to the asknasa hashtag and go to @nasa

414
00:17:14,470 --> 00:17:11,540
persevere and we'll try to get you an

415
00:17:16,960 --> 00:17:14,480
answer on that so Florian on YouTube

416
00:17:23,079 --> 00:17:16,970
asks how does perseverance Rovers team

417
00:17:27,069 --> 00:17:23,089
balance decisions ah so it's a really

418
00:17:31,000 --> 00:17:27,079
good question so a lot of the team comes

419
00:17:34,030 --> 00:17:31,010
from the curiosity Mars rover team and

420
00:17:36,730 --> 00:17:34,040
so what we found is that there's a

421
00:17:39,370 --> 00:17:36,740
balance constantly between how things

422
00:17:41,850 --> 00:17:39,380
were done on curiosity and how we wanna

423
00:17:44,919 --> 00:17:41,860
make things better for Mars 2020 um

424
00:17:47,640 --> 00:17:44,929
without adding additional risk so I

425
00:17:50,140 --> 00:17:47,650
think there's a really fine line between

426
00:17:52,600 --> 00:17:50,150
making things new and fancy for the sake

427
00:17:55,690 --> 00:17:52,610
of making them too fancy and using this

428
00:17:58,390 --> 00:17:55,700
heritage because you know that it's a

429
00:18:01,030 --> 00:17:58,400
heritage design what works and of course

430
00:18:05,820 --> 00:18:01,040
even with that there's a risk that maybe

431
00:18:08,140 --> 00:18:05,830
the design that worked was some sort of

432
00:18:11,440 --> 00:18:08,150
negative negative or positive positive

433
00:18:13,539 --> 00:18:11,450
where you know two things went between

434
00:18:15,880 --> 00:18:13,549
themselves and it ended up with the

435
00:18:18,010 --> 00:18:15,890
positive design so we have to constantly

436
00:18:20,980 --> 00:18:18,020
keep digging into the design to

437
00:18:23,649 --> 00:18:20,990
understand how to proceed forward I

438
00:18:27,399 --> 00:18:23,659

don't know if that totally answered your

439
00:18:30,310 --> 00:18:27,409
question but I think in general because

440
00:18:31,460 --> 00:18:30,320
we have the team from curiosity it's

441
00:18:34,190 --> 00:18:31,470
helped us to

442
00:18:36,860 --> 00:18:34,200
really mesh well now as a tune for 2020

443
00:18:39,730 --> 00:18:36,870
to have those kind of experts on board

444
00:18:42,710 --> 00:18:39,740
but then I'll also have this new wave of

445
00:18:46,370 --> 00:18:42,720
new team members coming in and out of

446
00:18:49,970 --> 00:18:46,380
their perspective - its you and then

447
00:18:52,430 --> 00:18:49,980
crews m7 also asks how does a system

448
00:18:55,549 --> 00:18:52,440
engineer work with different aspects

449
00:18:58,640 --> 00:18:55,559
like EDL and if you could define EDL or

450
00:19:01,789 --> 00:18:58,650
electronics and do you have to be SME in

451
00:19:07,850 --> 00:19:01,799
several areas to be able to take on a

452
00:19:11,230 --> 00:19:07,860
systems role yeah so I'm personally I

453
00:19:13,640 --> 00:19:11,240
jumped from thermal systems engineering

454
00:19:15,409 --> 00:19:13,650
inter thermal engineering I guess we

455
00:19:17,149 --> 00:19:15,419
would call it internet systems

456
00:19:19,419 --> 00:19:17,159
engineering so I came with a strong

457
00:19:21,950 --> 00:19:19,429
background in thermal and thermal

458
00:19:24,560 --> 00:19:21,960
specifically is an area that spans all

459
00:19:28,279 --> 00:19:24,570
the different Hardware pieces so I found

460
00:19:31,310 --> 00:19:28,289
that that adjust that was fine for you

461
00:19:33,919 --> 00:19:31,320
don't have to have been an expert in

462
00:19:36,080 --> 00:19:33,929
every single field in order to become a

463
00:19:37,850 --> 00:19:36,090

good systems engineer in order to become

464
00:19:39,860 --> 00:19:37,860
a good systems engineer you have to know

465
00:19:42,500 --> 00:19:39,870
that you don't know everything and have

466
00:19:45,190 --> 00:19:42,510
a willingness to learn I guess if that

467
00:19:47,270 --> 00:19:45,200
makes sense I think having experience

468
00:19:49,730 --> 00:19:47,280
digging in deep to these different

469
00:19:52,789 --> 00:19:49,740
subsystems makes you an even better

470
00:19:55,130 --> 00:19:52,799
systems engineer and and certainly I

471
00:19:56,600 --> 00:19:55,140
think usually when they hire systems

472
00:19:59,570 --> 00:19:56,610
engineers they do look for people that

473
00:20:01,820 --> 00:19:59,580
do come from some specific background so

474
00:20:04,340 --> 00:20:01,830
hopefully that helps answer the second

475
00:20:06,799 --> 00:20:04,350
part the question there was a first part

476
00:20:09,200 --> 00:20:06,809
of the question I missed yeah how does

477
00:20:15,409 --> 00:20:09,210
the systems engineer work with different

478
00:20:17,060 --> 00:20:15,419
aspects like EDL or electronics um gosh

479
00:20:22,159 --> 00:20:17,070
how do you work with those different

480
00:20:24,620 --> 00:20:22,169
aspects well so et al is an entry

481
00:20:28,039 --> 00:20:24,630
descent and landing phase of the mission

482
00:20:30,200 --> 00:20:28,049
and so evl is a systems engineering

483
00:20:34,610 --> 00:20:30,210
problem in and of itself and that

484
00:20:37,010 --> 00:20:34,620
includes electronics and so I think in

485
00:20:39,080 --> 00:20:37,020
order to put together things like ETL

486
00:20:41,149 --> 00:20:39,090
with electronics with the telecom system

487
00:20:41,880 --> 00:20:41,159
all of those sorts of things the best

488
00:20:44,460 --> 00:20:41,890

met best

489
00:20:46,680 --> 00:20:44,470
methods have really been to just dig

490
00:20:48,720 --> 00:20:46,690
into them and learn as much as you can

491
00:20:51,180 --> 00:20:48,730
and I don't know sounds kind of like a

492
00:20:55,860 --> 00:20:51,190
vague answer but it's really the only

493
00:20:57,450 --> 00:20:55,870
way that I've found to be most

494
00:20:59,880 --> 00:20:57,460
successful in some of the trades are

495
00:21:01,620 --> 00:20:59,890
just learning as much as you can and

496
00:21:05,070 --> 00:21:01,630
knowing that you don't know everything

497
00:21:07,800 --> 00:21:05,080
and with that you learn to talk to

498
00:21:10,380 --> 00:21:07,810
people talk to all sorts of different

499
00:21:12,030 --> 00:21:10,390
kinds of people I think at JPL there's

500
00:21:14,730 --> 00:21:12,040
lots of different personalities and so

501
00:21:15,690 --> 00:21:14,740
you get a slate you know in any industry

502
00:21:17,730 --> 00:21:15,700
there's lots of different personalities

503
00:21:19,260 --> 00:21:17,740
so you get a flavor of how to tell those

504
00:21:22,260 --> 00:21:19,270
interactions with people and really

505
00:21:24,660 --> 00:21:22,270
learn from them learn to trust and not

506
00:21:27,150 --> 00:21:24,670
trust what people are telling you trust

507
00:21:30,420 --> 00:21:27,160
but verify I guess is the way to say it

508
00:21:32,400 --> 00:21:30,430
so yeah again I'm not sure every totally

509
00:21:35,240 --> 00:21:32,410
answered that but if we gave a little

510
00:21:37,950 --> 00:21:35,250
guidance based on my own experience I

511
00:21:39,660 --> 00:21:37,960
think that this is a perfect setup for

512
00:21:42,690 --> 00:21:39,670
this question that it's kind of a

513
00:21:44,340 --> 00:21:42,700

follow-up Elizabeth on YouTube asks what

514
00:21:49,020 --> 00:21:44,350
are some of the traits that are most

515
00:21:54,180 --> 00:21:49,030
important for a systems engineer oh yes

516
00:21:55,920 --> 00:21:54,190
very good meeting yeah I think so

517
00:21:58,200 --> 00:21:55,930
systems engineers right the willingness

518
00:22:00,510 --> 00:21:58,210
to learn I think is a big one the

519
00:22:01,620 --> 00:22:00,520
ability to see this gray space I think

520
00:22:05,010 --> 00:22:01,630
I've talked about that before

521
00:22:06,480 --> 00:22:05,020
but um to know that the answer might not

522
00:22:09,450 --> 00:22:06,490
be black or white and you might not have

523
00:22:11,010 --> 00:22:09,460
a hundred percent or zero percentage to

524
00:22:15,540 --> 00:22:11,020
work through those sorts of situations

525
00:22:17,130 --> 00:22:15,550
um I guess I don't know I'd like to

526
00:22:19,440 --> 00:22:17,140
think that you kind of have to be a

527
00:22:22,410 --> 00:22:19,450
little bit social because I find myself

528
00:22:24,570 --> 00:22:22,420
talking to people a lot and learning

529
00:22:27,270 --> 00:22:24,580
from them but then also trading

530
00:22:30,690 --> 00:22:27,280
information with them so like if I'm

531
00:22:31,830 --> 00:22:30,700
talking to a Power Systems Engineer and

532
00:22:34,260 --> 00:22:31,840
I'm hearing them say things about

533
00:22:36,030 --> 00:22:34,270
thermal and I might be aware of the

534
00:22:38,730 --> 00:22:36,040
thermal system problems are having I can

535
00:22:40,140 --> 00:22:38,740
help guide the power systems engineer so

536
00:22:42,120 --> 00:22:40,150
that we can all be informed of the

537
00:22:44,550 --> 00:22:42,130
problem I think a lot of it is also

538
00:22:46,380 --> 00:22:44,560

guiding the team to have a common

539
00:22:49,530 --> 00:22:46,390
knowledge of the system instead of just

540
00:22:51,510 --> 00:22:49,540
having team members in a specific rabbit

541
00:22:54,600 --> 00:22:51,520
hole and trying to understand their

542
00:22:55,650 --> 00:22:54,610
problems that way um I think of like

543
00:23:01,350 --> 00:22:55,660
specific

544
00:23:07,590 --> 00:23:01,360
things really well organized I mean do

545
00:23:10,620 --> 00:23:07,600
you have to be good at math yes I think

546
00:23:13,740 --> 00:23:10,630
you have to be willing to learn and to

547
00:23:16,500 --> 00:23:13,750
be very precise I think that's the most

548
00:23:18,600 --> 00:23:16,510
important thing do you think your

549
00:23:21,510 --> 00:23:18,610
creative side also played a role in this

550
00:23:25,500 --> 00:23:21,520
too what you used to do versus what you

551
00:23:28,440 --> 00:23:25,510
do now does it parallels than that yeah

552
00:23:30,420 --> 00:23:28,450
I think um I guess I'm given it was a

553
00:23:34,020 --> 00:23:30,430
little bit of thought in the last few

554
00:23:36,000 --> 00:23:34,030
years when we were orchestrating these

555
00:23:37,620 --> 00:23:36,010
tests and bringing these big teams of

556
00:23:40,080 --> 00:23:37,630
people together with the system level

557
00:23:42,360 --> 00:23:40,090
testing I found myself kind of acting

558
00:23:43,710 --> 00:23:42,370
like a stage manager you know bringing

559
00:23:46,530 --> 00:23:43,720
all these different people into the

560
00:23:49,020 --> 00:23:46,540
picture I think someone else had

561
00:23:51,420 --> 00:23:49,030
mentioned systems engineers are kind of

562
00:23:53,160 --> 00:23:51,430
like the producers so you have to if you

563
00:23:54,360 --> 00:23:53,170

see a problem and one thing is going in

564
00:23:56,430 --> 00:23:54,370
this direction you have to kind of

565
00:23:58,380 --> 00:23:56,440
offset that with this thing so it's a

566
00:24:00,290 --> 00:23:58,390
constant trade and keeping the system

567
00:24:02,730 --> 00:24:00,300
balanced and everything like that so

568
00:24:04,590 --> 00:24:02,740
that's been kind of fun I guess

569
00:24:06,540 --> 00:24:04,600
systems engineering is also really

570
00:24:09,000 --> 00:24:06,550
interesting because you you transition

571
00:24:11,070 --> 00:24:09,010
with the mission so you know you start

572
00:24:12,840 --> 00:24:11,080
out in the design phase so you have to

573
00:24:14,790 --> 00:24:12,850
have a specific set of skills for design

574
00:24:17,610 --> 00:24:14,800
when you get into the more of the

575
00:24:20,100 --> 00:24:17,620
testing verification validation of the

576
00:24:21,870 --> 00:24:20,110
mission I you know you have a different

577
00:24:24,180 --> 00:24:21,880
set of skills where you have to think

578
00:24:25,920 --> 00:24:24,190
about things analytically and then when

579
00:24:28,430 --> 00:24:25,930
you go to the operations phase that's

580
00:24:31,260 --> 00:24:28,440
where you're kind of in a hot seat and

581
00:24:32,790 --> 00:24:31,270
for me I've always thought that you know

582
00:24:35,040 --> 00:24:32,800
you kind of feel like a performer when

583
00:24:38,070 --> 00:24:35,050
you're an operator because on the spot

584
00:24:41,100 --> 00:24:38,080
and maybe there's not a stage there's a

585
00:24:42,840 --> 00:24:41,110
darkroom but um yeah I'm sure there's

586
00:24:45,210 --> 00:24:42,850
one creativity in there too

587
00:24:47,340 --> 00:24:45,220
I think that's a great answer and

588
00:24:50,100 --> 00:24:47,350

Marina's kind of switched gears here to

589
00:24:52,170 --> 00:24:50,110
Marley on YouTube who wants to know how

590
00:24:57,380 --> 00:24:52,180
long does it take to get from Earth to

591
00:25:00,930 --> 00:24:57,390
Mars yeah it takes about six months so

592
00:25:04,250 --> 00:25:00,940
for our Mars 2020 mission we have a

593
00:25:09,090 --> 00:25:04,260
slightly longer cruise period than they

594
00:25:12,390 --> 00:25:09,100
on MSL curiosity but yeah it takes about

595
00:25:21,210 --> 00:25:12,400
six months where you're landing now

596
00:25:23,060 --> 00:25:21,220
February 18th so we got money 21 yes

597
00:25:28,170 --> 00:25:23,070
very much

598
00:25:31,470 --> 00:25:28,180
and then we have another one from Julie

599
00:25:34,350 --> 00:25:31,480
on you to ask what's the hardest part of

600
00:25:43,640 --> 00:25:34,360
planning big system level tests and

601
00:25:48,180 --> 00:25:43,650
getting a mission ready for launch I

602
00:25:50,460 --> 00:25:48,190
think it's so it's the most difficult

603
00:25:53,340 --> 00:25:50,470
but it's also the most rewarding

604
00:25:57,210 --> 00:25:53,350
I think it's seeing the team come

605
00:25:58,020 --> 00:25:57,220
together so there are all these

606
00:25:59,480 --> 00:25:58,030
subsystems

607
00:26:01,410 --> 00:25:59,490
they've all been working independently

608
00:26:03,390 --> 00:26:01,420
maybe there's a little bit of cross

609
00:26:05,490 --> 00:26:03,400
talking between those subsystems but as

610
00:26:07,020 --> 00:26:05,500
part of a plan or planning for these

611
00:26:09,510 --> 00:26:07,030
system tests and even planning for

612
00:26:11,100 --> 00:26:09,520
launch you have to pull these people

613
00:26:15,260 --> 00:26:11,110

together and they come from such

614
00:26:17,220 --> 00:26:15,270
different expertise is and different

615
00:26:19,020 --> 00:26:17,230
processes even and different ways of

616
00:26:20,580 --> 00:26:19,030
doing things and you have to force them

617
00:26:22,080 --> 00:26:20,590
into different processes that you're

618
00:26:23,280 --> 00:26:22,090
going to use for launch or the process

619
00:26:26,190 --> 00:26:23,290
you're gonna use for the test or

620
00:26:28,590 --> 00:26:26,200
whatever it may be and it's it's

621
00:26:31,350 --> 00:26:28,600
difficult to get people on board with

622
00:26:32,790 --> 00:26:31,360
new processes and new ways of doing

623
00:26:35,280 --> 00:26:32,800
things and new ways of thinking about

624
00:26:37,380 --> 00:26:35,290
the spacecraft so all those sorts of

625
00:26:38,970 --> 00:26:37,390
things I I found it was the most

626
00:26:40,920 --> 00:26:38,980
rewarding because after these tests

627
00:26:43,620 --> 00:26:40,930
completed and as they were you know

628
00:26:46,710 --> 00:26:43,630
nearing preparation to begin and

629
00:26:48,360 --> 00:26:46,720
complete you really saw the team's start

630
00:26:51,060 --> 00:26:48,370
to mesh and to start to talk to each

631
00:26:52,800 --> 00:26:51,070
other and instead of having me or you

632
00:26:54,360 --> 00:26:52,810
know one of my colleagues as one of the

633
00:26:56,250 --> 00:26:54,370
middle people you see them actually

634
00:26:57,660 --> 00:26:56,260
talking to each other now and so it's

635
00:27:00,090 --> 00:26:57,670
just this really cool meshing of the

636
00:27:02,880 --> 00:27:00,100
team it's difficult buddy it's a lot of

637
00:27:06,690 --> 00:27:02,890
it's really a nice community when it

638
00:27:09,080 --> 00:27:06,700

does happen that's great and then I have

639
00:27:11,940 --> 00:27:09,090
one last question and it's from

640
00:27:14,580 --> 00:27:11,950
eight-year-old Sienna and she wants to

641
00:27:16,220 --> 00:27:14,590
know tell us more about the type of

642
00:27:18,409 --> 00:27:16,230
dancing you did and

643
00:27:26,710 --> 00:27:18,419
tell us how science and art both make

644
00:27:32,900 --> 00:27:26,720
you happy oh gosh um okay so I used to

645
00:27:34,340 --> 00:27:32,910
do ballet tap and jazz and when I was in

646
00:27:38,030 --> 00:27:34,350
college I took a little bit of modern

647
00:27:41,150 --> 00:27:38,040
dance and I did a lot of theater musical

648
00:27:43,340 --> 00:27:41,160
theater have you and I would always get

649
00:27:46,100 --> 00:27:43,350
cast as the kind of like quirky nerdy

650
00:27:49,850 --> 00:27:46,110
character in school so there's always

651
00:27:53,150 --> 00:27:49,860
some type casting going on there too

652
00:27:56,390 --> 00:27:53,160
so yeah that's what I used to do what

653
00:27:58,070 --> 00:27:56,400
was the second part of the question just

654
00:28:03,530 --> 00:27:58,080
really quickly how do they both make you

655
00:28:06,200 --> 00:28:03,540
happy oh gosh in such different ways it

656
00:28:07,159 --> 00:28:06,210
uses different parts of your soul I

657
00:28:10,789 --> 00:28:07,169
guess so

658
00:28:13,850 --> 00:28:10,799
dance me singing and I guess even acting

659
00:28:17,030 --> 00:28:13,860
um you know that kind of gets out like

660
00:28:20,510 --> 00:28:17,040
my my soul and like performing I was

661
00:28:24,020 --> 00:28:20,520
getting very cheesy but it's it's very

662
00:28:26,240 --> 00:28:24,030
true um and then the engineering it

663
00:28:28,970 --> 00:28:26,250

really gets like my brain so I think it

664
00:28:31,820 --> 00:28:28,980
fulfills that curiosity in your brain

665
00:28:34,549 --> 00:28:31,830
that you get a little bit of that with

666
00:28:36,620 --> 00:28:34,559
dance but it really gets fulfilled a bit

667
00:28:40,010 --> 00:28:36,630
'space and with all the different

668
00:28:43,130 --> 00:28:40,020
missions going on at JPL and so I find

669
00:28:44,840 --> 00:28:43,140
that you have to have I think in Pilates

670
00:28:46,669 --> 00:28:44,850
they say I think of mind and body you

671
00:28:49,490 --> 00:28:46,679
have to fulfill both and so I think

672
00:28:52,159 --> 00:28:49,500
through dance I found it in my body and

673
00:28:58,070 --> 00:28:52,169
through science I found it in my brain

674
00:28:59,960 --> 00:28:58,080
so it's great thank you so much for

675
00:29:01,580 --> 00:28:59,970
answering the questions today and thank

676
00:29:03,770 --> 00:29:01,590
you for everyone who submitted your

677
00:29:05,120 --> 00:29:03,780
questions and I just want to thank you

678
00:29:08,450 --> 00:29:05,130
personally for talking to us today

679
00:29:12,110 --> 00:29:08,460
Heather thank you guys so much

680
00:29:14,990 --> 00:29:12,120
yeah this is awesome yeah great now the

681
00:29:17,750 --> 00:29:15,000
launch period for Mars 2020 opens on

682
00:29:21,350 --> 00:29:17,760
July 17th and the rover is slated to

683
00:29:23,750 --> 00:29:21,360
land on the Red Planet February 18 20 21

684
00:29:26,450 --> 00:29:23,760
for the latest on the mission follow

685
00:29:28,909 --> 00:29:26,460
@nasa persevere on Twitter and Facebook

686
00:29:29,530 --> 00:29:28,919
and you can watch all the behind the

687
00:29:32,890 --> 00:29:29,540
space crap

688
00:29:35,470 --> 00:29:32,900

video profiles on the NASA 360 YouTube

689
00:29:38,380 --> 00:29:35,480
channel now we will be doing it live Q&A

690
00:29:41,410 --> 00:29:38,390
s for the Mars 2020 team members every

691
00:29:43,600 --> 00:29:41,420
Thursday at 1:00 p.m. Pacific time 4:00

692
00:29:46,240 --> 00:29:43,610
p.m. Eastern for the next few weeks and

693
00:29:48,700 --> 00:29:46,250
if you want to explore the universe from

694
00:29:52,090 --> 00:29:48,710
the comfort of your home check out our

695
00:29:55,330 --> 00:29:52,100
NASA at home activities for families and

696
00:29:58,810 --> 00:29:55,340
kids of all ages you can find them on