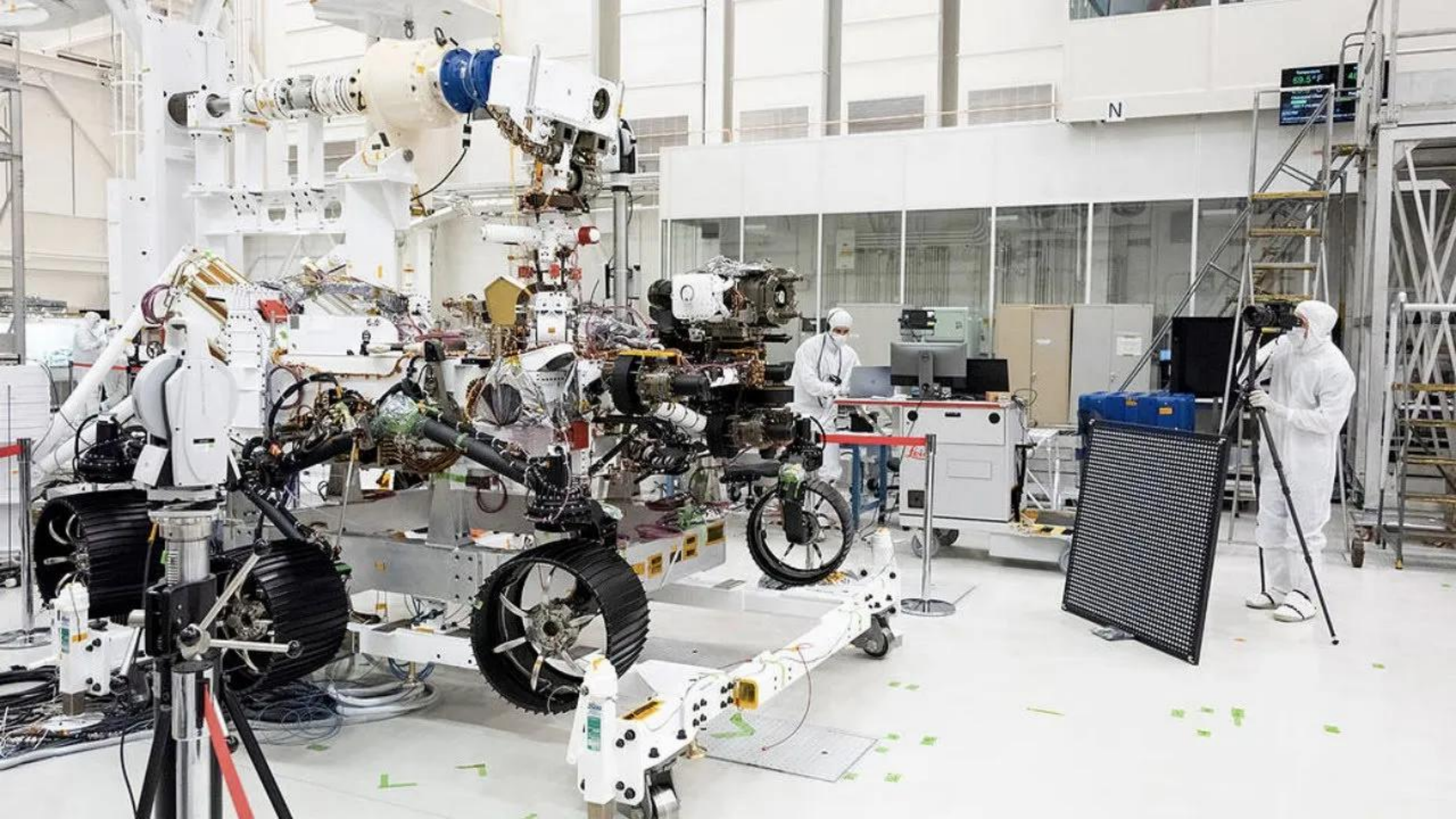

1
00:00:04,870 --> 00:00:02,550
allowed us to literally go back in time

2
00:00:07,070 --> 00:00:04,880
on mars

3
00:00:10,390 --> 00:00:07,080
the first picture will cover an area of

4
00:00:13,509 --> 00:00:10,400
176 miles mariner 4 began transmitting

5
00:00:15,910 --> 00:00:13,519
back images the first photograph that a

6
00:00:18,910 --> 00:00:15,920
human being has ever seen from the

7
00:00:21,830 --> 00:00:18,920
surface of another planet on august 20th

8
00:00:24,550 --> 00:00:21,840
1975 the first viking spaceship was

9
00:00:27,429 --> 00:00:24,560
launched you were seeing something that

10
00:00:31,080 --> 00:00:27,439
no other human has ever seen before

11
00:00:36,150 --> 00:00:31,090
former seas and mountains huge canyons

12
00:00:40,709 --> 00:00:38,150
that sense of wonderment and achievement

13
00:00:44,630 --> 00:00:40,719

and always working towards your goal

14
00:00:52,229 --> 00:00:44,640
we can do and we will do

15
00:00:57,270 --> 00:00:55,189
mars is unavoidably special we've landed

16
00:00:58,470 --> 00:00:57,280
and we've scooped we've roved we've

17
00:01:01,349 --> 00:00:58,480
orbited

18
00:01:03,430 --> 00:01:01,359
together we did it but the attitude was

19
00:01:05,830 --> 00:01:03,440
together we can do it

20
00:01:08,940 --> 00:01:05,840
the future is what you make out of it

21
00:01:11,190 --> 00:01:08,950
you can make it real

22
00:01:13,990 --> 00:01:11,200
[Music]

23
00:01:16,070 --> 00:01:14,000
and here we are with mars perseverance

24
00:01:18,950 --> 00:01:16,080
51 years later getting ready to do the

25
00:01:20,870 --> 00:01:18,960
first ever mars return mission

26
00:01:22,950 --> 00:01:20,880
eventually we can bring those samples

27
00:01:24,149 --> 00:01:22,960
back to earth and determine for the very

28
00:01:33,670 --> 00:01:24,159
first time

29
00:01:38,149 --> 00:01:35,670
i'm dc eagle of nasa's jet propulsion

30
00:01:39,749 --> 00:01:38,159
laboratory in southern california we're

31
00:01:41,749 --> 00:01:39,759
here at the kennedy space center to talk

32
00:01:44,389 --> 00:01:41,759
about nasa's next mission to the red

33
00:01:45,270 --> 00:01:44,399
planet mars 2020 and the perseverance

34
00:01:46,389 --> 00:01:45,280
rover

35
00:01:47,990 --> 00:01:46,399
and we're going to be talking about the

36
00:01:50,069 --> 00:01:48,000
science and engineering that's going to

37
00:01:52,230 --> 00:01:50,079
make this mission a great mission

38
00:01:53,670 --> 00:01:52,240

here to talk about mars 2020 we have

39
00:01:55,749 --> 00:01:53,680
today

40
00:01:58,230 --> 00:01:55,759
lori glaze

41
00:01:59,429 --> 00:01:58,240
the director of the planetary science

42
00:02:01,190 --> 00:01:59,439
division

43
00:02:03,109 --> 00:02:01,200
at nasa headquarters

44
00:02:06,389 --> 00:02:03,119
in washington

45
00:02:09,270 --> 00:02:06,399
and across the country we have with us

46
00:02:13,430 --> 00:02:09,280
jennifer trosper the deputy project

47
00:02:17,270 --> 00:02:13,440
manager for mars 2020 at jpl

48
00:02:20,390 --> 00:02:17,280
also at jpl we have farah alibay and

49
00:02:23,830 --> 00:02:20,400
she's a mobility engineer for mars 2020

50
00:02:25,990 --> 00:02:23,840
and she's of course also at jpl

51
00:02:28,150 --> 00:02:26,000
now back here at the kennedy space

52
00:02:30,949 --> 00:02:28,160
center media site we have

53
00:02:33,589 --> 00:02:30,959
ken farley who is the project scientist

54
00:02:36,869 --> 00:02:33,599
for mars 2020

55
00:02:39,589 --> 00:02:36,879
and he is from caltech

56
00:02:42,070 --> 00:02:39,599
finally we have tanya bozak and she's a

57
00:02:44,390 --> 00:02:42,080
mars 2020 scientist

58
00:02:45,670 --> 00:02:44,400
from mit

59
00:02:47,110 --> 00:02:45,680
so we're going to start things out with

60
00:02:47,830 --> 00:02:47,120
lori glaze lori

61
00:02:48,830 --> 00:02:47,840
great

62
00:02:52,309 --> 00:02:48,840
thanks

63
00:02:54,949 --> 00:02:52,319

dc so as tc says i'm the director for

64
00:02:57,589 --> 00:02:54,959
the planetary science division at nasa

65
00:03:00,949 --> 00:02:57,599
and the main goal of nasa's planetary

66
00:03:02,630 --> 00:03:00,959
program is to explore the solar system

67
00:03:04,630 --> 00:03:02,640
to help us answer important questions

68
00:03:06,790 --> 00:03:04,640
about how the planets formed and how

69
00:03:08,790 --> 00:03:06,800
they evolved and of course there's a lot

70
00:03:10,790 --> 00:03:08,800
of really special places to go

71
00:03:13,350 --> 00:03:10,800
throughout the solar system but mars has

72
00:03:15,910 --> 00:03:13,360
always held a special place in that

73
00:03:17,589 --> 00:03:15,920
exploration if i could have the first

74
00:03:20,550 --> 00:03:17,599
graphic please

75
00:03:23,830 --> 00:03:20,560
going back to the mariner missions the

76
00:03:25,990 --> 00:03:23,840
mariner flybys and the viking landings

77
00:03:28,630 --> 00:03:26,000
mars has always held that special place

78
00:03:31,030 --> 00:03:28,640
up through even our current missions

79
00:03:32,949 --> 00:03:31,040
the current series of orbiters and

80
00:03:35,270 --> 00:03:32,959
landers and rovers that are currently

81
00:03:38,470 --> 00:03:35,280
operating on the surface today and of

82
00:03:40,710 --> 00:03:38,480
course leading up to uh to perseverance

83
00:03:42,309 --> 00:03:40,720
which is about to launch

84
00:03:44,229 --> 00:03:42,319
some of the reasons why we've always

85
00:03:46,550 --> 00:03:44,239
found mars to just be such a special

86
00:03:48,309 --> 00:03:46,560
place and so fascinating for one

87
00:03:50,630 --> 00:03:48,319
it's relatively accessible it's

88
00:03:52,309 --> 00:03:50,640

relatively close in the solar system we

89
00:03:54,789 --> 00:03:52,319
can get there we can arrive in a matter

90
00:03:56,390 --> 00:03:54,799
of about six to seven months

91
00:03:59,270 --> 00:03:56,400
so that's relatively short on the

92
00:04:01,589 --> 00:03:59,280
planetary exploration time scale but in

93
00:04:04,470 --> 00:04:01,599
addition it also holds a lot of really

94
00:04:06,470 --> 00:04:04,480
unique scientific value particularly for

95
00:04:08,710 --> 00:04:06,480
trying to understand planets with rocky

96
00:04:10,309 --> 00:04:08,720
surfaces and planets with atmospheres

97
00:04:12,390 --> 00:04:10,319
helping us understand how they form and

98
00:04:15,589 --> 00:04:12,400
evolve and help us better understand our

99
00:04:17,749 --> 00:04:15,599
own history on earth

100
00:04:21,030 --> 00:04:17,759
mars preserves on its surface some

101
00:04:22,870 --> 00:04:21,040
incredibly complex and diverse geology

102
00:04:24,870 --> 00:04:22,880
on earth of course our crust is

103
00:04:26,870 --> 00:04:24,880
constantly recycled

104
00:04:28,790 --> 00:04:26,880
weathered and eroded and so it's very

105
00:04:30,710 --> 00:04:28,800
hard to find places that have preserved

106
00:04:33,030 --> 00:04:30,720
that history from billions of years ago

107
00:04:35,430 --> 00:04:33,040
and yet on mars we can find places where

108
00:04:37,350 --> 00:04:35,440
we see that full breadth of history

109
00:04:38,390 --> 00:04:37,360
preserved onto the surface on the

110
00:04:39,909 --> 00:04:38,400
surface

111
00:04:41,990 --> 00:04:39,919
it also of course is a planet with an

112
00:04:44,230 --> 00:04:42,000
atmosphere it has a climate just like

113
00:04:46,070 --> 00:04:44,240

earth has a climate and much like earth

114
00:04:48,390 --> 00:04:46,080
the climate on mars has changed over

115
00:04:50,469 --> 00:04:48,400
time and so by understanding when and

116
00:04:52,310 --> 00:04:50,479
how that climate has changed helped us

117
00:04:54,790 --> 00:04:52,320
better understand our own climate

118
00:04:56,710 --> 00:04:54,800
evolution on earth

119
00:04:58,390 --> 00:04:56,720
it's also a place where

120
00:05:00,230 --> 00:04:58,400
on the surface since it's so old it's

121
00:05:02,790 --> 00:05:00,240
preserved we've also understood that in

122
00:05:04,469 --> 00:05:02,800
the last uh few about 20 years we've

123
00:05:06,150 --> 00:05:04,479
come to better understand that the

124
00:05:08,469 --> 00:05:06,160
surface of mars was actually probably

125
00:05:10,710 --> 00:05:08,479
much warmer and wetter in the past with

126
00:05:12,550 --> 00:05:10,720
a denser atmosphere and that perhaps

127
00:05:15,270 --> 00:05:12,560
several billion years ago

128
00:05:17,830 --> 00:05:15,280
life could have possibly taken form on

129
00:05:20,629 --> 00:05:17,840
mars as well similar as it did on earth

130
00:05:23,029 --> 00:05:20,639
and by going back to mars we might be

131
00:05:24,950 --> 00:05:23,039
able to find evidence of when life could

132
00:05:26,950 --> 00:05:24,960
have taken place or could have taken

133
00:05:29,110 --> 00:05:26,960
hold on mars this is a study of

134
00:05:30,790 --> 00:05:29,120
astrobiology of understanding the

135
00:05:32,390 --> 00:05:30,800
environments that could support life and

136
00:05:34,950 --> 00:05:32,400
understanding if and when life can

137
00:05:37,029 --> 00:05:34,960
actually come to be and march 2020

138
00:05:39,189 --> 00:05:37,039

perseverance is in fact our first

139
00:05:41,350 --> 00:05:39,199
mission from nasa that's specifically

140
00:05:43,990 --> 00:05:41,360
designed to answer these astrobiology

141
00:05:46,550 --> 00:05:44,000
questions on mars if i could have the

142
00:05:48,390 --> 00:05:46,560
next graphic please

143
00:05:50,790 --> 00:05:48,400
but everyone will tell you that this is

144
00:05:52,390 --> 00:05:50,800
an incredibly complex mission but they

145
00:05:54,550 --> 00:05:52,400
didn't do it alone all of those that

146
00:05:56,950 --> 00:05:54,560
worked on this mission are

147
00:05:58,550 --> 00:05:56,960
leaning on the legacy of all those

148
00:06:00,950 --> 00:05:58,560
rovers that have come before from

149
00:06:04,469 --> 00:06:00,960
sojourner to spirit and opportunity to

150
00:06:06,230 --> 00:06:04,479
curiosity and now to perseverance

151
00:06:08,309 --> 00:06:06,240
we're building on that legacy of what's

152
00:06:09,990 --> 00:06:08,319
come before but perseverance is also

153
00:06:11,830 --> 00:06:10,000
laying the groundwork for what comes

154
00:06:13,350 --> 00:06:11,840
next you're going to hear a lot today

155
00:06:14,790 --> 00:06:13,360
about the incredible science that

156
00:06:17,270 --> 00:06:14,800
perseverance is going to do on the

157
00:06:18,950 --> 00:06:17,280
surface of mars and about its main goal

158
00:06:21,510 --> 00:06:18,960
which is to collect some samples to

159
00:06:23,350 --> 00:06:21,520
bring back to earth in the future and

160
00:06:25,510 --> 00:06:23,360
our next big mission of course is going

161
00:06:26,710 --> 00:06:25,520
to be mars sample return where we plan

162
00:06:31,029 --> 00:06:26,720
to

163
00:06:33,189 --> 00:06:31,039

mars and execute the first ever launch

164
00:06:35,029 --> 00:06:33,199
from the surface of another planet and

165
00:06:36,790 --> 00:06:35,039
that whole mission we focus on trying to

166
00:06:38,230 --> 00:06:36,800
bring those samples those very precious

167
00:06:40,870 --> 00:06:38,240
samples back to earth where we can

168
00:06:43,430 --> 00:06:40,880
analyze them here with our uh incredibly

169
00:06:45,110 --> 00:06:43,440
capable uh laboratories here on earth

170
00:06:47,510 --> 00:06:45,120
and all of this is also then leading

171
00:06:49,749 --> 00:06:47,520
towards potential human exploration come

172
00:06:51,670 --> 00:06:49,759
in the coming decades we've got specific

173
00:06:53,430 --> 00:06:51,680
technologies on the perseverance rover

174
00:06:55,029 --> 00:06:53,440
that you'll hear about that are also

175
00:06:56,790 --> 00:06:55,039
going to be talking about that will be

176
00:06:58,390 --> 00:06:56,800
demonstrating these core capabilities

177
00:07:00,550 --> 00:06:58,400
that we're going to need in order to

178
00:07:02,469 --> 00:07:00,560
support human exploration

179
00:07:04,710 --> 00:07:02,479
in those coming decades and i wanted to

180
00:07:06,710 --> 00:07:04,720
just give a plug real quick for two more

181
00:07:08,469 --> 00:07:06,720
uh conference press conferences that

182
00:07:09,990 --> 00:07:08,479
will be held tomorrow afternoon uh for

183
00:07:11,749 --> 00:07:10,000
both the technologies and for mars

184
00:07:14,230 --> 00:07:11,759
sample return if you want to learn more

185
00:07:16,230 --> 00:07:14,240
about those two things as well

186
00:07:17,909 --> 00:07:16,240
and so right now what i'd like to do is

187
00:07:19,350 --> 00:07:17,919
hand it over to jennifer trosper who's

188
00:07:22,629 --> 00:07:19,360

actually worked on all five of the

189
00:07:25,830 --> 00:07:22,639
rovers that have successfully uh

190
00:07:28,550 --> 00:07:25,840
been delivered to mars by nasa and jpl

191
00:07:29,990 --> 00:07:28,560
jennifer is the deputy project scientist

192
00:07:31,189 --> 00:07:30,000
for surface operations she's going to

193
00:07:33,350 --> 00:07:31,199
tell us a little bit more about the

194
00:07:35,029 --> 00:07:33,360
rovers themselves the rover itself and

195
00:07:39,350 --> 00:07:35,039
about what we're going to do once we get

196
00:07:44,629 --> 00:07:41,749
thanks lori well it's great to be here

197
00:07:47,189 --> 00:07:44,639
today and i'm very excited to tell you

198
00:07:49,029 --> 00:07:47,199
about our new rover perseverance but i

199
00:07:51,510 --> 00:07:49,039
have to look back and say

200
00:07:54,309 --> 00:07:51,520
you know as a as a farm girl on a

201
00:07:56,230 --> 00:07:54,319
growing up in ohio it it took me a while

202
00:07:59,189 --> 00:07:56,240
to get the rover bug now i've worked on

203
00:08:02,469 --> 00:07:59,199
all of these rovers but i didn't work on

204
00:08:04,390 --> 00:08:02,479
robotics growing up but in 1997 i had

205
00:08:07,029 --> 00:08:04,400
the opportunity to be part of the mars

206
00:08:09,189 --> 00:08:07,039
pathfinder team with the sojourner rover

207
00:08:11,830 --> 00:08:09,199
and ever since that day when we landed

208
00:08:14,550 --> 00:08:11,840
on mars and i i saw the fun and the

209
00:08:16,629 --> 00:08:14,560
excitement and the and the i got the bug

210
00:08:18,710 --> 00:08:16,639
of exploration and so now i've worked on

211
00:08:21,029 --> 00:08:18,720
every mars rover it's been a privilege

212
00:08:23,110 --> 00:08:21,039
not just to work on the rovers but also

213
00:08:24,869 --> 00:08:23,120

to work with the great teams that build

214
00:08:26,629 --> 00:08:24,879
these rovers and today i'm going to tell

215
00:08:28,550 --> 00:08:26,639
you about our next great rover

216
00:08:29,909 --> 00:08:28,560
perseverance now go ahead and show the

217
00:08:34,310 --> 00:08:29,919
first slide

218
00:08:35,990 --> 00:08:34,320
rovers you see the small rover is

219
00:08:38,149 --> 00:08:36,000
sojourner rover the one i just talked

220
00:08:41,110 --> 00:08:38,159
about and then we have spirit and

221
00:08:43,430 --> 00:08:41,120
opportunity the mid-sized go-kart rover

222
00:08:46,070 --> 00:08:43,440
and then curiosity which is more like a

223
00:08:48,550 --> 00:08:46,080
small car and now we have perseverance

224
00:08:51,110 --> 00:08:48,560
and as i look back over my career of

225
00:08:53,509 --> 00:08:51,120
working on these rovers it's exciting to

226
00:08:55,350 --> 00:08:53,519
see how we just incrementally built up

227
00:08:57,910 --> 00:08:55,360
the capabilities of the engineering and

228
00:09:00,790 --> 00:08:57,920
the science to have this enormously

229
00:09:02,310 --> 00:09:00,800
capable rover today called perseverance

230
00:09:04,230 --> 00:09:02,320
this i'm going to talk a little bit

231
00:09:06,710 --> 00:09:04,240
about what those capabilities are i

232
00:09:09,110 --> 00:09:06,720
would say perseverance is unique in that

233
00:09:11,910 --> 00:09:09,120
all of her capabilities are very much

234
00:09:14,790 --> 00:09:11,920
focused on her science mission now her

235
00:09:15,670 --> 00:09:14,800
science mission is challenging she needs

236
00:09:16,790 --> 00:09:15,680
to go

237
00:09:19,430 --> 00:09:16,800
explore

238
00:09:22,070 --> 00:09:19,440

find select

239
00:09:24,070 --> 00:09:22,080
actually core and cash samples for

240
00:09:25,990 --> 00:09:24,080
future return to earth and so we've

241
00:09:28,630 --> 00:09:26,000
needed to add a lot of new things to

242
00:09:31,110 --> 00:09:28,640
perseverance to make her able to do that

243
00:09:33,110 --> 00:09:31,120
and we want her to do that in a location

244
00:09:34,630 --> 00:09:33,120
that is interesting enough to find

245
00:09:37,190 --> 00:09:34,640
samples that we want to bring back to

246
00:09:39,910 --> 00:09:37,200
earth and so that brought us to needing

247
00:09:41,430 --> 00:09:39,920
to add our first new technology our

248
00:09:44,230 --> 00:09:41,440
first new technology was terrain

249
00:09:46,230 --> 00:09:44,240
relative navigation now we leveraged a

250
00:09:48,550 --> 00:09:46,240
lot of the curiosity entry descent and

251
00:09:50,470 --> 00:09:48,560
landing system but when ken farley and

252
00:09:52,630 --> 00:09:50,480
the science team decided that they

253
00:09:54,790 --> 00:09:52,640
wanted to land at jezreel crater we

254
00:09:57,030 --> 00:09:54,800
realized that the current sky crane

255
00:09:59,269 --> 00:09:57,040
landing system would not land us there

256
00:10:00,230 --> 00:09:59,279
safely enough and so you know you can

257
00:10:02,069 --> 00:10:00,240
kind of think if it's more

258
00:10:04,230 --> 00:10:02,079
scientifically interesting than it has

259
00:10:06,630 --> 00:10:04,240
more engineering hazards so you can go

260
00:10:09,030 --> 00:10:06,640
here to my next graphic which shows what

261
00:10:10,550 --> 00:10:09,040
terrain relative navigation is the

262
00:10:12,069 --> 00:10:10,560
engineering team

263
00:10:14,150 --> 00:10:12,079

you know got on board to say well we

264
00:10:16,949 --> 00:10:14,160
need to make this landing site safe and

265
00:10:19,430 --> 00:10:16,959
so we added what is essentially our

266
00:10:21,590 --> 00:10:19,440
astronaut that we take to mars that

267
00:10:23,990 --> 00:10:21,600
steers us away from hazards and we call

268
00:10:26,949 --> 00:10:24,000
it terrain relative navigation we can't

269
00:10:28,389 --> 00:10:26,959
take an astronaut so we load uh mars

270
00:10:30,230 --> 00:10:28,399
orbital maps that we get from the

271
00:10:31,829 --> 00:10:30,240
orbiters that are marked with hazards

272
00:10:34,550 --> 00:10:31,839
and then we use a camera to take

273
00:10:36,069 --> 00:10:34,560
pictures as we're descending onto mars

274
00:10:38,710 --> 00:10:36,079
and then we compare those figure out

275
00:10:41,110 --> 00:10:38,720
where we are in the map and then divert

276
00:10:43,269 --> 00:10:41,120
by firing engines to get away from the

277
00:10:45,910 --> 00:10:43,279
hazards so that we can land safely so

278
00:10:47,269 --> 00:10:45,920
this new technology allows us to land in

279
00:10:48,710 --> 00:10:47,279
jezreel crater which is where the

280
00:10:50,389 --> 00:10:48,720
science team wants to go to do this

281
00:10:52,550 --> 00:10:50,399
investigation

282
00:10:54,069 --> 00:10:52,560
now another interesting part of entry

283
00:10:56,870 --> 00:10:54,079
descent and landing now entry descent

284
00:10:58,550 --> 00:10:56,880
landing is always harrowing it's it's

285
00:11:00,630 --> 00:10:58,560
hard right it's

286
00:11:03,030 --> 00:11:00,640
mars is 100 million miles away you start

287
00:11:04,870 --> 00:11:03,040
at 12 00 12 000 miles per hour at the

288
00:11:07,509 --> 00:11:04,880

top of the atmosphere you have to get to

289
00:11:09,590 --> 00:11:07,519
zero seven minutes later and so it's a

290
00:11:12,790 --> 00:11:09,600
nail-biting thing and we've added

291
00:11:14,710 --> 00:11:12,800
something to uh perseverance which is

292
00:11:17,430 --> 00:11:14,720
especially cool so that we will get a

293
00:11:19,750 --> 00:11:17,440
front row seat the vehicle actually has

294
00:11:21,430 --> 00:11:19,760
the ability to take selfies as it's

295
00:11:23,509 --> 00:11:21,440
going through the entry descent and

296
00:11:24,630 --> 00:11:23,519
landing process go ahead and show my

297
00:11:26,630 --> 00:11:24,640
next slide

298
00:11:29,350 --> 00:11:26,640
this shows you where the cameras are

299
00:11:31,430 --> 00:11:29,360
that we have added to take pictures as

300
00:11:34,230 --> 00:11:31,440
we're descending onto the surface of

301
00:11:36,470 --> 00:11:34,240
mars we have parachute up cameras that

302
00:11:37,829 --> 00:11:36,480
will watch the parachute inflation

303
00:11:39,590 --> 00:11:37,839
on the descent stage we have some

304
00:11:41,750 --> 00:11:39,600
download cameras that will watch the

305
00:11:43,509 --> 00:11:41,760
rover go down on the sky crane on the

306
00:11:45,110 --> 00:11:43,519
rover we have upload and download

307
00:11:46,870 --> 00:11:45,120
cameras the upload cameras watch the

308
00:11:49,430 --> 00:11:46,880
descent stage and we'll get the fly away

309
00:11:51,590 --> 00:11:49,440
moment which is awesome and then the the

310
00:11:53,910 --> 00:11:51,600
download cameras will watch the surface

311
00:11:56,310 --> 00:11:53,920
as we're placed on the ground on mars

312
00:11:58,389 --> 00:11:56,320
very exciting we also have a microphone

313
00:12:00,550 --> 00:11:58,399

on the rover so we're listening to

314
00:12:02,389 --> 00:12:00,560
ourselves as we go through the

315
00:12:04,710 --> 00:12:02,399
atmosphere of mars we're listening to

316
00:12:06,710 --> 00:12:04,720
the the pyro firings and the hardware

317
00:12:08,790 --> 00:12:06,720
being released it's going to be one of

318
00:12:10,710 --> 00:12:08,800
the most exciting things that happens

319
00:12:12,550 --> 00:12:10,720
early in this mission and i'm really

320
00:12:14,310 --> 00:12:12,560
looking forward to it we'll record all

321
00:12:16,389 --> 00:12:14,320
that data and then we'll send it back

322
00:12:18,470 --> 00:12:16,399
shortly after landing

323
00:12:20,069 --> 00:12:18,480
now the next thing that's exciting about

324
00:12:22,069 --> 00:12:20,079
this river you know entry setting

325
00:12:24,629 --> 00:12:22,079
landing is always exciting but it's only

326
00:12:26,150 --> 00:12:24,639
seven minutes and my personal favorite

327
00:12:28,550 --> 00:12:26,160
part of the mission is the surface

328
00:12:31,110 --> 00:12:28,560
mission which for perseverance is going

329
00:12:34,150 --> 00:12:31,120
to last for a mars year which is about

330
00:12:36,629 --> 00:12:34,160
two earth years and this perseverance

331
00:12:39,190 --> 00:12:36,639
mission has to do the equivalent of

332
00:12:40,870 --> 00:12:39,200
about what curiosity did or four times

333
00:12:42,870 --> 00:12:40,880
what curiosity did

334
00:12:45,430 --> 00:12:42,880
in the same amount of time and so we've

335
00:12:47,910 --> 00:12:45,440
had to do a lot of things to make it

336
00:12:49,750 --> 00:12:47,920
smarter and so go ahead and bring up my

337
00:12:52,150 --> 00:12:49,760
next slide

338
00:12:53,430 --> 00:12:52,160

you can see that this is one of the

339
00:12:55,910 --> 00:12:53,440
things that we've done to make it

340
00:12:58,069 --> 00:12:55,920
smarter and have better sensing is we've

341
00:13:00,470 --> 00:12:58,079
added some cameras you can see we have

342
00:13:02,629 --> 00:13:00,480
23 cameras on the rover

343
00:13:05,350 --> 00:13:02,639
and some of the new cameras we've added

344
00:13:07,269 --> 00:13:05,360
we have new double e cams that are

345
00:13:09,670 --> 00:13:07,279
navigation cameras that we use for

346
00:13:11,750 --> 00:13:09,680
autonomous driving they're now color

347
00:13:14,230 --> 00:13:11,760
they're twice twice the field of view

348
00:13:16,310 --> 00:13:14,240
twice the resolution as the curiosity

349
00:13:17,990 --> 00:13:16,320
cameras we also have added better

350
00:13:20,389 --> 00:13:18,000
cameras to the front of the rover the

351
00:13:23,190 --> 00:13:20,399
hazard cameras which we use to actually

352
00:13:25,030 --> 00:13:23,200
place the arm very accurately we even

353
00:13:27,030 --> 00:13:25,040
have a camera inside the rover that

354
00:13:29,590 --> 00:13:27,040
takes images of the samples before we

355
00:13:32,069 --> 00:13:29,600
seal them off so we have lots of great

356
00:13:34,389 --> 00:13:32,079
sensors and another thing that we do to

357
00:13:36,550 --> 00:13:34,399
make the rover smarter is we add a lot

358
00:13:38,629 --> 00:13:36,560
of software and computers so if you can

359
00:13:41,110 --> 00:13:38,639
go on to my next graphic

360
00:13:43,350 --> 00:13:41,120
i can show you a little bit about what

361
00:13:46,230 --> 00:13:43,360
makes the rover smart

362
00:13:48,949 --> 00:13:46,240
the rover has about 13 different

363
00:13:51,590 --> 00:13:48,959

computing and processors it has

364
00:13:53,430 --> 00:13:51,600
dozens of electronics boxes i can't show

365
00:13:55,990 --> 00:13:53,440
you the software and the algorithms that

366
00:13:57,910 --> 00:13:56,000
make it smart but this is the inside of

367
00:13:59,670 --> 00:13:57,920
the rover the the back of the river is

368
00:14:01,430 --> 00:13:59,680
to the right the front of the rover is

369
00:14:03,189 --> 00:14:01,440
to the left and you can't even see the

370
00:14:05,750 --> 00:14:03,199
full sample caching system which is

371
00:14:07,750 --> 00:14:05,760
another extraordinarily complex part of

372
00:14:10,550 --> 00:14:07,760
the rover if you were to take all the

373
00:14:12,790 --> 00:14:10,560
cables inside the rover it would um it

374
00:14:15,829 --> 00:14:12,800
would be about three and a half miles

375
00:14:17,829 --> 00:14:15,839
long so it's a very complicated vehicle

376
00:14:19,189 --> 00:14:17,839
but we've made it smarter

377
00:14:21,030 --> 00:14:19,199
the things that we've done to make it

378
00:14:23,430 --> 00:14:21,040
smarter some of the new algorithms i

379
00:14:26,230 --> 00:14:23,440
talked about terrain relative navigation

380
00:14:28,870 --> 00:14:26,240
we've also added a new auto navigation

381
00:14:31,030 --> 00:14:28,880
algorithm so that we can actually drive

382
00:14:33,189 --> 00:14:31,040
autonomously through more difficult

383
00:14:35,189 --> 00:14:33,199
terrains that have more rocks we've

384
00:14:37,030 --> 00:14:35,199
added a capability for higher

385
00:14:38,870 --> 00:14:37,040
compression so that we can get more data

386
00:14:40,470 --> 00:14:38,880
down to the ground we've added a

387
00:14:43,350 --> 00:14:40,480
capability so that after the rover

388
00:14:44,870 --> 00:14:43,360

drives it can stop check for hazards and

389
00:14:47,430 --> 00:14:44,880
if there are no hazards it can actually

390
00:14:49,110 --> 00:14:47,440
deploy the arm out and take some images

391
00:14:50,710 --> 00:14:49,120
and send those back to earth so that we

392
00:14:52,550 --> 00:14:50,720
don't have to wait for the next day and

393
00:14:54,230 --> 00:14:52,560
it speeds things up

394
00:14:56,629 --> 00:14:54,240
we've also made some significant

395
00:14:58,790 --> 00:14:56,639
upgrades to our operations system we

396
00:15:01,030 --> 00:14:58,800
have cloud-based tools that allow the

397
00:15:03,189 --> 00:15:01,040
science team to do collaboration around

398
00:15:05,269 --> 00:15:03,199
targeting and visualization and we're

399
00:15:06,949 --> 00:15:05,279
much more efficient at simulating and

400
00:15:09,110 --> 00:15:06,959
validating those sequences because we

401
00:15:10,470 --> 00:15:09,120
have to send those to the rover every

402
00:15:13,030 --> 00:15:10,480
single day

403
00:15:15,590 --> 00:15:13,040
and now if you'll go ahead to my my next

404
00:15:17,590 --> 00:15:15,600
slide which is my final image

405
00:15:18,629 --> 00:15:17,600
i love this image because it shows the

406
00:15:19,750 --> 00:15:18,639
rover

407
00:15:20,949 --> 00:15:19,760
folded up

408
00:15:24,150 --> 00:15:20,959
ready to go

409
00:15:26,550 --> 00:15:24,160
on its way to mars but it also shows

410
00:15:28,230 --> 00:15:26,560
the preeminent new capability that we've

411
00:15:30,550 --> 00:15:28,240
built on this rover which is the

412
00:15:32,470 --> 00:15:30,560
sampling system if you look at the front

413
00:15:34,150 --> 00:15:32,480

of the rover you see the cage-like

414
00:15:36,629 --> 00:15:34,160
feature that's the core

415
00:15:39,670 --> 00:15:36,639
that cores the samples from the surface

416
00:15:41,350 --> 00:15:39,680
of mars you'll also see the robotic arm

417
00:15:43,749 --> 00:15:41,360
you can see the forearm and the upper

418
00:15:46,389 --> 00:15:43,759
arm that have the mars 2020 and the

419
00:15:48,870 --> 00:15:46,399
perseverance plates on them

420
00:15:50,710 --> 00:15:48,880
you'll also be able to see the the big

421
00:15:52,949 --> 00:15:50,720
carousel which is sort of in the center

422
00:15:54,790 --> 00:15:52,959
the round thing a couple other things to

423
00:15:57,269 --> 00:15:54,800
say about this image the wheels are

424
00:15:59,189 --> 00:15:57,279
covered with anti-static wrap and we do

425
00:16:01,030 --> 00:15:59,199
take that off before launch so no

426
00:16:02,870 --> 00:16:01,040
worries there and then you can see the

427
00:16:04,710 --> 00:16:02,880
rover's upside down in this picture so

428
00:16:06,629 --> 00:16:04,720
you see the mast is actually stowed

429
00:16:08,389 --> 00:16:06,639
underneath the rover you can see the

430
00:16:09,430 --> 00:16:08,399
american flag there at the bottom of the

431
00:16:11,430 --> 00:16:09,440
mast

432
00:16:13,430 --> 00:16:11,440
now something that just kind of brings

433
00:16:15,829 --> 00:16:13,440
it home as far as how

434
00:16:17,910 --> 00:16:15,839
amazing this rover is

435
00:16:19,430 --> 00:16:17,920
is the turret that's on the end of the

436
00:16:21,990 --> 00:16:19,440
robotic arm

437
00:16:24,310 --> 00:16:22,000
that includes the core and also includes

438
00:16:25,430 --> 00:16:24,320

some other instruments it weighs 80

439
00:16:27,110 --> 00:16:25,440
pounds

440
00:16:29,670 --> 00:16:27,120
and i think if you had told me back in

441
00:16:30,870 --> 00:16:29,680
1997 when i was working on the sojourner

442
00:16:32,710 --> 00:16:30,880
rover

443
00:16:34,550 --> 00:16:32,720
that in 20 years we'd be building a

444
00:16:36,230 --> 00:16:34,560
rover that had a robotic arm that could

445
00:16:38,069 --> 00:16:36,240
hold the weight of three sojourner

446
00:16:40,230 --> 00:16:38,079
rovers in its hand

447
00:16:42,710 --> 00:16:40,240
i might have been surprised but here it

448
00:16:45,030 --> 00:16:42,720
is it's the perseverance rover it's an

449
00:16:47,509 --> 00:16:45,040
amazing vehicle and with that i'm going

450
00:16:50,069 --> 00:16:47,519
to hand it off to farah alibay who will

451
00:16:52,470 --> 00:16:50,079
talk more about the mobility system

452
00:16:54,230 --> 00:16:52,480
thank you so much jennifer perseverance

453
00:16:55,910 --> 00:16:54,240
has some of the most ambitious science

454
00:16:57,350 --> 00:16:55,920
goals that we've ever attempted on the

455
00:16:59,269 --> 00:16:57,360
surface of mars

456
00:17:01,670 --> 00:16:59,279
now in order to achieve these we need to

457
00:17:04,069 --> 00:17:01,680
travel long distances and over a variety

458
00:17:06,470 --> 00:17:04,079
of terrains the enabling technology for

459
00:17:07,829 --> 00:17:06,480
this is the rover's mobility system now

460
00:17:09,909 --> 00:17:07,839
let's queue up my first video where

461
00:17:12,230 --> 00:17:09,919
you'll see the rover driving here in our

462
00:17:13,590 --> 00:17:12,240
clean room and while you look at that i

463
00:17:15,110 --> 00:17:13,600

can talk you through some of the specs

464
00:17:17,429 --> 00:17:15,120
the rover has

465
00:17:20,069 --> 00:17:17,439
perseverance is a rugged all-terrain

466
00:17:23,590 --> 00:17:20,079
vehicle it has a clearance of two feet a

467
00:17:26,470 --> 00:17:23,600
wheel diameter of 21 inches it can go

468
00:17:28,789 --> 00:17:26,480
over obstacles of up to 40 centimeters

469
00:17:30,630 --> 00:17:28,799
that's just over a foot and it can go up

470
00:17:33,830 --> 00:17:30,640
slopes of up to 30 degrees so that's

471
00:17:36,230 --> 00:17:33,840
about a 57 percent grade

472
00:17:38,710 --> 00:17:36,240
the rover has a top speed of 0.1 mile

473
00:17:40,950 --> 00:17:38,720
per hour but most importantly it can

474
00:17:42,950 --> 00:17:40,960
self-drive on mars now remember mars

475
00:17:45,990 --> 00:17:42,960
doesn't have roads it doesn't have maps

476
00:17:47,990 --> 00:17:46,000
it doesn't have gps and yet perseverance

477
00:17:50,150 --> 00:17:48,000
can self-drive for distances of up to

478
00:17:52,150 --> 00:17:50,160
200 meters per day

479
00:17:53,830 --> 00:17:52,160
in order to get there in order to get to

480
00:17:56,710 --> 00:17:53,840
these specs we've had to make some

481
00:17:58,549 --> 00:17:56,720
pretty significant upgrades from

482
00:18:01,110 --> 00:17:58,559
uh from perseverance predecessor which

483
00:18:03,110 --> 00:18:01,120
was curiosity the first upgrade that we

484
00:18:04,470 --> 00:18:03,120
made is to its wheels and let's look at

485
00:18:06,470 --> 00:18:04,480
slide number two where you'll see the

486
00:18:08,710 --> 00:18:06,480
difference between the curiosity and the

487
00:18:10,710 --> 00:18:08,720
perseverance wheels and we essentially

488
00:18:12,549 --> 00:18:10,720

went back to the drawing board here you

489
00:18:14,710 --> 00:18:12,559
can see that the perseverance tread

490
00:18:16,390 --> 00:18:14,720
pattern is much tighter much closer

491
00:18:18,390 --> 00:18:16,400
together and the treads are actually

492
00:18:19,430 --> 00:18:18,400
taller which gives the wheels better

493
00:18:21,750 --> 00:18:19,440
traction

494
00:18:24,150 --> 00:18:21,760
you can also see that the treads have a

495
00:18:26,390 --> 00:18:24,160
smooth sinusitis pattern rather than the

496
00:18:28,470 --> 00:18:26,400
jagged pattern that curiosity had

497
00:18:30,549 --> 00:18:28,480
that gives that gets rid of the hot

498
00:18:33,430 --> 00:18:30,559
spots that cause damage on the curiosity

499
00:18:34,950 --> 00:18:33,440
wheels and gives us confidence with that

500
00:18:36,390 --> 00:18:34,960
and along with the hundreds of hours of

501
00:18:38,870 --> 00:18:36,400
testing obviously that we've done here

502
00:18:40,870 --> 00:18:38,880
on earth that these wheels will survive

503
00:18:42,549 --> 00:18:40,880
the harsh martian environment that they

504
00:18:44,870 --> 00:18:42,559
will be driving on

505
00:18:47,110 --> 00:18:44,880
the biggest upgrade that we've made to

506
00:18:49,750 --> 00:18:47,120
the perseverance rover however is its

507
00:18:52,390 --> 00:18:49,760
self-driving capability perseverance is

508
00:18:55,110 --> 00:18:52,400
able to self-drive three times faster

509
00:18:57,510 --> 00:18:55,120
than the curiosity rover can and that is

510
00:18:58,710 --> 00:18:57,520
mostly due to its ability to think while

511
00:19:00,470 --> 00:18:58,720
it drives

512
00:19:02,870 --> 00:19:00,480
it's able to do what we call thinking

513
00:19:05,190 --> 00:19:02,880

while driving due to its additional

514
00:19:06,630 --> 00:19:05,200
computer the vision compute element or

515
00:19:11,510 --> 00:19:06,640
the vce

516
00:19:13,110 --> 00:19:11,520
enabled innate in order to enable

517
00:19:15,190 --> 00:19:13,120
terrain relative navigation which

518
00:19:17,270 --> 00:19:15,200
jennifer talked about but once we're on

519
00:19:19,909 --> 00:19:17,280
the surface we no longer need autorain

520
00:19:22,870 --> 00:19:19,919
relative navigation software so we reuse

521
00:19:25,990 --> 00:19:22,880
that second brain in order to speed up

522
00:19:28,150 --> 00:19:26,000
our autonomous navigation versus uh for

523
00:19:30,630 --> 00:19:28,160
our scarecrow rover scarecrow which you

524
00:19:32,870 --> 00:19:30,640
saw on that last picture is an earth

525
00:19:35,590 --> 00:19:32,880
version of our rover that has a third of

526
00:19:37,590 --> 00:19:35,600
the mass and essentially scarecrow has

527
00:19:39,909 --> 00:19:37,600
the same weight here on earth as

528
00:19:42,390 --> 00:19:39,919
perseverance will have on mars since

529
00:19:43,510 --> 00:19:42,400
mars has a third of the gravity that

530
00:19:45,590 --> 00:19:43,520
earth does

531
00:19:47,350 --> 00:19:45,600
so here on earth we'll be putting

532
00:19:49,350 --> 00:19:47,360
scarecrow through a variety of tests

533
00:19:51,909 --> 00:19:49,360
through our mazes and what we'll be

534
00:19:54,470 --> 00:19:51,919
doing using those tests is fine-tuning

535
00:19:57,350 --> 00:19:54,480
our self-driving parameters so that in

536
00:19:59,270 --> 00:19:57,360
february of 2021 when we land on mars

537
00:20:00,870 --> 00:19:59,280
we'll be ready to hit the ground running

538
00:20:02,549 --> 00:20:00,880

and get along with that fantastic

539
00:20:05,029 --> 00:20:02,559
science that we that we have in store

540
00:20:07,110 --> 00:20:05,039
for the rover and with that let me hand

541
00:20:08,310 --> 00:20:07,120
you over to project scientist ken foley

542
00:20:09,270 --> 00:20:08,320
who's going to talk to you about that

543
00:20:10,870 --> 00:20:09,280
science

544
00:20:13,270 --> 00:20:10,880
thanks thanks pharaoh

545
00:20:16,470 --> 00:20:13,280
as you've heard the march 2020 mission

546
00:20:18,390 --> 00:20:16,480
has three major goals the first is to

547
00:20:21,270 --> 00:20:18,400
seek the signs of life

548
00:20:23,190 --> 00:20:21,280
the second is to collect and cache a

549
00:20:24,789 --> 00:20:23,200
suite of samples that a future mission

550
00:20:27,590 --> 00:20:24,799
could bring back to earth

551
00:20:29,590 --> 00:20:27,600
and the third is to test technologies

552
00:20:31,750 --> 00:20:29,600
that future explorers of mars either

553
00:20:33,190 --> 00:20:31,760
robotic or possibly even human could

554
00:20:35,110 --> 00:20:33,200
take advantage of

555
00:20:36,630 --> 00:20:35,120
i could have the first graphic

556
00:20:38,710 --> 00:20:36,640
i want to tell you a little bit more

557
00:20:41,110 --> 00:20:38,720
about the rover and in particular about

558
00:20:43,029 --> 00:20:41,120
the science instruments we have seven

559
00:20:45,029 --> 00:20:43,039
entirely new instruments that we are

560
00:20:47,510 --> 00:20:45,039
flying with us

561
00:20:49,830 --> 00:20:47,520
and i want to focus on just two of them

562
00:20:53,270 --> 00:20:49,840
because they illustrate a completely new

563
00:20:54,950 --> 00:20:53,280

kind of capability for a rover mission

564
00:20:57,190 --> 00:20:54,960
and that is the pair of instruments that

565
00:20:58,789 --> 00:20:57,200
are on the robotic arm on the turret

566
00:21:00,630 --> 00:20:58,799
that jennifer talked about these two

567
00:21:01,669 --> 00:21:00,640
instruments are called sherlock and

568
00:21:04,070 --> 00:21:01,679
pixel

569
00:21:07,430 --> 00:21:04,080
and what they do is they allow us to

570
00:21:09,830 --> 00:21:07,440
combine or co-register in a single

571
00:21:11,750 --> 00:21:09,840
postage stamp size area

572
00:21:13,669 --> 00:21:11,760
things that you could see with your eyes

573
00:21:16,149 --> 00:21:13,679
like color and texture

574
00:21:18,470 --> 00:21:16,159
but also chemistry and mineralogy and

575
00:21:21,110 --> 00:21:18,480
this is a very powerful combination it's

576
00:21:23,750 --> 00:21:21,120
never been done before on mars and it

577
00:21:25,990 --> 00:21:23,760
will allow us to understand how rocks

578
00:21:28,149 --> 00:21:26,000
formed what their history has been since

579
00:21:29,909 --> 00:21:28,159
they formed and in particular is one of

580
00:21:31,190 --> 00:21:29,919
the key ways that we will look for

581
00:21:32,630 --> 00:21:31,200
evidence of life for what we call

582
00:21:34,230 --> 00:21:32,640
biosignatures

583
00:21:36,149 --> 00:21:34,240
and in that regard the sherlock

584
00:21:37,990 --> 00:21:36,159
instrument is particularly important

585
00:21:41,270 --> 00:21:38,000
because it will allow us to not only

586
00:21:43,510 --> 00:21:41,280
detect organic matter to but to also map

587
00:21:46,070 --> 00:21:43,520
its distribution in this microscopic

588
00:21:48,070 --> 00:21:46,080

area and this is of course organic

589
00:21:50,149 --> 00:21:48,080
matter is of course one of the key kinds

590
00:21:51,590 --> 00:21:50,159
of observations that one makes

591
00:21:54,549 --> 00:21:51,600
to identify

592
00:21:56,549 --> 00:21:54,559
past evidence of life

593
00:21:58,630 --> 00:21:56,559
in addition to those two instruments i

594
00:22:00,630 --> 00:21:58,640
want to expand on something that

595
00:22:01,990 --> 00:22:00,640
jennifer mentioned which is the sample

596
00:22:03,350 --> 00:22:02,000
caching system

597
00:22:06,549 --> 00:22:03,360
and i want to talk about something which

598
00:22:09,510 --> 00:22:06,559
i find really really cool

599
00:22:11,750 --> 00:22:09,520
this is a sample tube now jennifer told

600
00:22:14,070 --> 00:22:11,760
you that the sampling and caching system

601
00:22:16,710 --> 00:22:14,080
consists of a drill mounted out on the

602
00:22:19,190 --> 00:22:16,720
robotic arm and a system that processes

603
00:22:20,950 --> 00:22:19,200
the samples inside the rover well this

604
00:22:22,230 --> 00:22:20,960
is one of the really key elements of

605
00:22:24,630 --> 00:22:22,240
this whole thing

606
00:22:27,350 --> 00:22:24,640
this is a tube into which each

607
00:22:29,990 --> 00:22:27,360
individual sample will be drilled

608
00:22:31,590 --> 00:22:30,000
it is a very complicated device we we

609
00:22:33,110 --> 00:22:31,600
often liken it to a test tube but i

610
00:22:35,510 --> 00:22:33,120
think you can see it's got a lot of

611
00:22:37,430 --> 00:22:35,520
features that go beyond that simple

612
00:22:38,470 --> 00:22:37,440
description and i want to tell you about

613
00:22:41,350 --> 00:22:38,480

some of them

614
00:22:43,590 --> 00:22:41,360
first one of the key uh technologies

615
00:22:46,549 --> 00:22:43,600
that had to be developed for this is how

616
00:22:48,149 --> 00:22:46,559
to make it extraordinarily clean this is

617
00:22:50,070 --> 00:22:48,159
amongst the cleanest things that have

618
00:22:52,310 --> 00:22:50,080
ever been built certainly uh is the

619
00:22:54,549 --> 00:22:52,320
cleanest thing that has ever been flown

620
00:22:57,029 --> 00:22:54,559
in the sense that the inside of these

621
00:22:59,270 --> 00:22:57,039
tubes of which there are 43 on board the

622
00:23:01,750 --> 00:22:59,280
rover that look just like this inside of

623
00:23:04,950 --> 00:23:01,760
this tube has no microbes

624
00:23:06,950 --> 00:23:04,960
and is extremely clean of organic matter

625
00:23:09,190 --> 00:23:06,960
and that's necessary so that when

626
00:23:11,110 --> 00:23:09,200
the cousins of this tube come back to

627
00:23:13,430 --> 00:23:11,120
earth we can be certain that what's

628
00:23:15,750 --> 00:23:13,440
inside that tube actually came from mars

629
00:23:17,110 --> 00:23:15,760
and didn't come from earth

630
00:23:18,630 --> 00:23:17,120
there's several other features i can

631
00:23:20,789 --> 00:23:18,640
point out here

632
00:23:23,510 --> 00:23:20,799
it's got a serial number on it this will

633
00:23:25,270 --> 00:23:23,520
be very important for when the

634
00:23:26,549 --> 00:23:25,280
fetch mission goes to pick up this tube

635
00:23:27,750 --> 00:23:26,559
we'll know which one it is and we'll

636
00:23:29,590 --> 00:23:27,760
know where we collected it that's

637
00:23:32,470 --> 00:23:29,600
obviously super important

638
00:23:34,950 --> 00:23:32,480

and you see uh lots of indentations and

639
00:23:37,350 --> 00:23:34,960
and holes in the tube this is necessary

640
00:23:39,510 --> 00:23:37,360
so that the robotic system both on

641
00:23:41,830 --> 00:23:39,520
perseverance and on the follow-on

642
00:23:43,830 --> 00:23:41,840
missions can manipulate the tube

643
00:23:46,549 --> 00:23:43,840
and finally you also notice that it is

644
00:23:48,390 --> 00:23:46,559
bright white this is not paint

645
00:23:50,630 --> 00:23:48,400
paint would contaminate the sample with

646
00:23:53,029 --> 00:23:50,640
organic matter instead this is aluminum

647
00:23:54,950 --> 00:23:53,039
oxide which has been flame sprayed onto

648
00:23:57,110 --> 00:23:54,960
the surface and this is necessary so

649
00:23:58,789 --> 00:23:57,120
that when we cash the tube onto the

650
00:24:00,710 --> 00:23:58,799
surface put it down on the surface for

651
00:24:02,149 --> 00:24:00,720
the future mission to pick up it doesn't

652
00:24:04,310 --> 00:24:02,159
get too hot in the sun the white

653
00:24:06,149 --> 00:24:04,320
reflects the heat away so this is really

654
00:24:11,669 --> 00:24:06,159
one of the great features that has been

655
00:24:16,390 --> 00:24:13,590
and we spent a fair bit of time talking

656
00:24:18,230 --> 00:24:16,400
about the hardware of this mission

657
00:24:21,830 --> 00:24:18,240
but i also want to point out that this

658
00:24:23,990 --> 00:24:21,840
takes a very large team of people to run

659
00:24:26,390 --> 00:24:24,000
there are uh engineers who are

660
00:24:28,950 --> 00:24:26,400
responsible for commanding the rover and

661
00:24:31,350 --> 00:24:28,960
for ensuring its health and safety and

662
00:24:33,350 --> 00:24:31,360
there's also a very large science team

663
00:24:35,990 --> 00:24:33,360

which will guide the operations in the

664
00:24:38,710 --> 00:24:36,000
pursuit of the science goals

665
00:24:40,950 --> 00:24:38,720
the science team has about 350 members

666
00:24:42,630 --> 00:24:40,960
they come from all around the world and

667
00:24:44,549 --> 00:24:42,640
they range from

668
00:24:46,710 --> 00:24:44,559
students all the way through senior

669
00:24:48,549 --> 00:24:46,720
scientists and they represent an

670
00:24:51,110 --> 00:24:48,559
enormous diversity of scientific

671
00:24:52,710 --> 00:24:51,120
disciplines from people who are nitty

672
00:24:54,950 --> 00:24:52,720
gritty experts about what each

673
00:24:57,909 --> 00:24:54,960
instrument does and how it does it

674
00:25:01,590 --> 00:24:57,919
through to geologists and geochemists

675
00:25:05,029 --> 00:25:01,600
atmospheric scientists astrobiologists

676
00:25:06,710 --> 00:25:05,039
and this whole team has to work together

677
00:25:09,430 --> 00:25:06,720
one of the key things that jennifer

678
00:25:11,510 --> 00:25:09,440
mentioned is that we have a very

679
00:25:13,510 --> 00:25:11,520
ambitious mission planned and we need to

680
00:25:14,390 --> 00:25:13,520
work very efficiently

681
00:25:17,350 --> 00:25:14,400
and

682
00:25:20,470 --> 00:25:17,360
one of the reasons for this is that

683
00:25:22,390 --> 00:25:20,480
the team each and every day will receive

684
00:25:24,710 --> 00:25:22,400
data from the rover

685
00:25:27,430 --> 00:25:24,720
and on a very short time frame the team

686
00:25:29,590 --> 00:25:27,440
needs to interpret that data what

687
00:25:31,909 --> 00:25:29,600
questions did it answer what new

688
00:25:34,549 --> 00:25:31,919

questions did it raise and where do we

689
00:25:37,269 --> 00:25:34,559
go now and what observations do we make

690
00:25:38,789 --> 00:25:37,279
we have just a few hours to do that

691
00:25:40,789 --> 00:25:38,799
before we have to hand it back to the

692
00:25:43,110 --> 00:25:40,799
engineers who then beam instructions up

693
00:25:45,269 --> 00:25:43,120
to the rover to go and do that

694
00:25:46,470 --> 00:25:45,279
so this is a very time pressured

695
00:25:49,029 --> 00:25:46,480
activity

696
00:25:51,430 --> 00:25:49,039
and it is really important that the team

697
00:25:53,669 --> 00:25:51,440
know how to function together

698
00:25:56,310 --> 00:25:53,679
and unlike a piece of hardware where you

699
00:25:58,630 --> 00:25:56,320
can design how all the elements interact

700
00:25:59,750 --> 00:25:58,640
a human team is really quite different

701
00:26:01,669 --> 00:25:59,760
and one of the things that we've been

702
00:26:03,590 --> 00:26:01,679
working on over the last few years since

703
00:26:05,350 --> 00:26:03,600
this team got together is a kind of

704
00:26:08,310 --> 00:26:05,360
bonding and if i could have the

705
00:26:11,510 --> 00:26:09,990
one of the things that some of us on the

706
00:26:13,669 --> 00:26:11,520
team were fortunate enough to be able to

707
00:26:16,390 --> 00:26:13,679
do is to go out into the field in a

708
00:26:18,549 --> 00:26:16,400
remote part of western australia to look

709
00:26:20,549 --> 00:26:18,559
at rocks that contain the oldest

710
00:26:21,990 --> 00:26:20,559
undisputed evidence of life on earth

711
00:26:24,230 --> 00:26:22,000
very similar to the kinds of things that

712
00:26:26,470 --> 00:26:24,240
we hope we might find on mars and so

713
00:26:28,149 --> 00:26:26,480

this was really a great activity so that

714
00:26:32,630 --> 00:26:28,159
we could all come together and really

715
00:26:36,950 --> 00:26:34,470
we are now about

716
00:26:39,350 --> 00:26:36,960
three days away from the launch

717
00:26:43,830 --> 00:26:39,360
and we will arrive perseverance will

718
00:26:45,750 --> 00:26:43,840
arrive on mars in uh february of 2021

719
00:26:48,149 --> 00:26:45,760
that gives us about seven months in

720
00:26:50,070 --> 00:26:48,159
which the team science team will not be

721
00:26:52,950 --> 00:26:50,080
relaxing instead the science team is

722
00:26:55,110 --> 00:26:52,960
working to develop a plan for how we

723
00:26:58,070 --> 00:26:55,120
will investigate our landing site if i

724
00:26:59,350 --> 00:26:58,080
can have the final clip

725
00:27:01,430 --> 00:26:59,360
one of the things we've been doing is

726
00:27:03,590 --> 00:27:01,440
developing a notional traverse of how

727
00:27:05,269 --> 00:27:03,600
the rover will move through its landing

728
00:27:07,029 --> 00:27:05,279
site so in blue you see the landing

729
00:27:09,510 --> 00:27:07,039
ellipse and in white you see the

730
00:27:11,110 --> 00:27:09,520
traverse that the rover may take

731
00:27:13,510 --> 00:27:11,120
and this shows that we have wonderful

732
00:27:16,149 --> 00:27:13,520
data from the orbiters that have been

733
00:27:18,389 --> 00:27:16,159
around mars to guide us in the selection

734
00:27:21,190 --> 00:27:18,399
of key targets to further our science

735
00:27:23,190 --> 00:27:21,200
goals and also the way we can traverse

736
00:27:24,710 --> 00:27:23,200
the rover through various hazards so

737
00:27:26,549 --> 00:27:24,720
we're very excited to continue to work

738
00:27:28,630 --> 00:27:26,559

on that and then actually start

739
00:27:30,549 --> 00:27:28,640
executing as soon as we get to mars

740
00:27:32,389 --> 00:27:30,559
early next year

741
00:27:35,110 --> 00:27:32,399
and with that i will turn it over to

742
00:27:38,230 --> 00:27:35,120
tonya bozak who is a science team member

743
00:27:40,149 --> 00:27:38,240
and also an expert at looking for

744
00:27:42,710 --> 00:27:40,159
biosignatures in ancient terrestrial

745
00:27:46,710 --> 00:27:44,870
thank you ken as someone who spent a lot

746
00:27:48,549 --> 00:27:46,720
of time thinking

747
00:27:51,110 --> 00:27:48,559
what life was like

748
00:27:52,310 --> 00:27:51,120
on earth omar's three billion years ago

749
00:27:55,669 --> 00:27:52,320
or more

750
00:27:59,510 --> 00:27:55,679
i think that jezera crater is an amazing

751
00:28:02,789 --> 00:27:59,520
site to examine and sample the process

752
00:28:06,630 --> 00:28:02,799
by which we arrived to this landing site

753
00:28:08,549 --> 00:28:06,640
to choose it was long it started in 2014

754
00:28:10,389 --> 00:28:08,559
with the first landing site workshop

755
00:28:12,310 --> 00:28:10,399
which was open to the entire community

756
00:28:14,149 --> 00:28:12,320
so anyone could come and suggest their

757
00:28:15,350 --> 00:28:14,159
favorite landing site and there were

758
00:28:19,669 --> 00:28:15,360
discussions

759
00:28:23,029 --> 00:28:19,679
led to the narrowing down of the number

760
00:28:25,110 --> 00:28:23,039
down to three sites in 2018 and then in

761
00:28:27,590 --> 00:28:25,120
november 2018

762
00:28:28,870 --> 00:28:27,600
dr thomas zurbukin made the final choice

763
00:28:29,990 --> 00:28:28,880

of jazzero

764
00:28:32,389 --> 00:28:30,000
and uh

765
00:28:35,830 --> 00:28:32,399
the choice is pretty obvious when you

766
00:28:38,470 --> 00:28:35,840
think about what we can see from space

767
00:28:40,870 --> 00:28:38,480
that tells us a lot about jezreel as a

768
00:28:43,430 --> 00:28:40,880
previously inhabited previously

769
00:28:45,430 --> 00:28:43,440
habitable environment so if i can have

770
00:28:46,710 --> 00:28:45,440
the first slide

771
00:28:49,269 --> 00:28:46,720
here is

772
00:28:52,470 --> 00:28:49,279
a photograph taken from space of the

773
00:28:54,070 --> 00:28:52,480
jezreel crater uh this crater occurs in

774
00:28:56,630 --> 00:28:54,080
very old terrain

775
00:29:00,070 --> 00:28:56,640
uh the crater itself is probably 3.8

776
00:29:01,990 --> 00:29:00,080
billion years old this is an amazingly

777
00:29:04,710 --> 00:29:02,000
old environment

778
00:29:07,029 --> 00:29:04,720
and what we can see from this

779
00:29:08,710 --> 00:29:07,039
about the the crater itself is about 50

780
00:29:12,070 --> 00:29:08,720
kilometers wide

781
00:29:15,029 --> 00:29:12,080
and in this dashed area we see a fan you

782
00:29:16,149 --> 00:29:15,039
see this fan already in 10 slides

783
00:29:18,630 --> 00:29:16,159
um

784
00:29:21,029 --> 00:29:18,640
we know what forms these kinds of

785
00:29:21,909 --> 00:29:21,039
fan-like deposits on earth

786
00:29:24,630 --> 00:29:21,919
and

787
00:29:27,430 --> 00:29:24,640
those deltas deltas

788
00:29:29,110 --> 00:29:27,440

occur when rivers

789
00:29:31,430 --> 00:29:29,120
flow through terrains and bring

790
00:29:33,510 --> 00:29:31,440
sediments into standing bodies of water

791
00:29:35,190 --> 00:29:33,520
so just by looking at this picture we

792
00:29:37,269 --> 00:29:35,200
can tell that there was a staining body

793
00:29:39,269 --> 00:29:37,279
of water that was there long enough for

794
00:29:41,110 --> 00:29:39,279
these sediments to be deposited and form

795
00:29:42,870 --> 00:29:41,120
these geomorphic features

796
00:29:44,710 --> 00:29:42,880
so great there was a sustained body of

797
00:29:46,710 --> 00:29:44,720
water

798
00:29:49,110 --> 00:29:46,720
some time ago what did it look like so

799
00:29:52,830 --> 00:29:49,120
if i can have the movie that follows

800
00:29:55,830 --> 00:29:52,840
this is an artist tradition of a fly

801
00:29:58,470 --> 00:29:55,840
over many billion years ago over the

802
00:30:01,990 --> 00:29:58,480
crater so if you can play the movie we

803
00:30:03,590 --> 00:30:02,000
see on the left there is the inflow

804
00:30:07,029 --> 00:30:03,600
channel that

805
00:30:10,710 --> 00:30:07,039
kept filling this crater with water

806
00:30:12,710 --> 00:30:10,720
the water uh level was rising

807
00:30:14,310 --> 00:30:12,720
to the point when the outflow channel

808
00:30:15,110 --> 00:30:14,320
formed to the right

809
00:30:18,070 --> 00:30:15,120
and

810
00:30:19,669 --> 00:30:18,080
that lasted for some time long enough to

811
00:30:22,310 --> 00:30:19,679
create a delta

812
00:30:24,950 --> 00:30:22,320
now we know a lot about deltas on earth

813
00:30:26,789 --> 00:30:24,960

and part of what makes delta environment

814
00:30:28,630 --> 00:30:26,799
so attractive is that they sample

815
00:30:30,710 --> 00:30:28,640
sediments from the surrounding regions

816
00:30:32,230 --> 00:30:30,720
these very old regions would have been

817
00:30:34,230 --> 00:30:32,240
very old on mars

818
00:30:35,990 --> 00:30:34,240
so by looking at the sediments there we

819
00:30:37,430 --> 00:30:36,000
can learn about the surrounding regions

820
00:30:39,430 --> 00:30:37,440
on mars

821
00:30:41,510 --> 00:30:39,440
however for bias signatures it's even

822
00:30:43,669 --> 00:30:41,520
more exciting because deltas are great

823
00:30:45,430 --> 00:30:43,679
at preserving organic matter and other

824
00:30:48,070 --> 00:30:45,440
types of biosignatures

825
00:30:50,149 --> 00:30:48,080
and what we also know already from just

826
00:30:51,750 --> 00:30:50,159
orbital spectroscopy if i can have the

827
00:30:53,750 --> 00:30:51,760
next slide please

828
00:30:55,029 --> 00:30:53,760
there are diverse minerals present in

829
00:30:57,350 --> 00:30:55,039
the delta

830
00:31:00,710 --> 00:30:57,360
and within our landing ellipse and the

831
00:31:04,149 --> 00:31:00,720
projected rotor trajectory so here's a

832
00:31:06,630 --> 00:31:04,159
false color image these are not the real

833
00:31:08,870 --> 00:31:06,640
colors on mars unfortunately it is not

834
00:31:10,630 --> 00:31:08,880
so colorful but what these different

835
00:31:11,669 --> 00:31:10,640
colors show

836
00:31:16,870 --> 00:31:11,679
are

837
00:31:19,269 --> 00:31:16,880
delta you can see some purples you can

838
00:31:21,110 --> 00:31:19,279

see some greens

839
00:31:23,029 --> 00:31:21,120
some of this tells us that there are a

840
00:31:25,029 --> 00:31:23,039
lot of clay minerals that are known in

841
00:31:27,590 --> 00:31:25,039
there to preserve goodbye signatures the

842
00:31:29,509 --> 00:31:27,600
green areas in particular

843
00:31:31,830 --> 00:31:29,519
you can see this green that really

844
00:31:33,909 --> 00:31:31,840
follows the rim of the crater but in the

845
00:31:35,669 --> 00:31:33,919
areas where the waters of the lake

846
00:31:37,110 --> 00:31:35,679
former lake would have been lapping the

847
00:31:39,269 --> 00:31:37,120
shore

848
00:31:41,750 --> 00:31:39,279
and that is great

849
00:31:43,750 --> 00:31:41,760
for bias signatures if some of these

850
00:31:46,230 --> 00:31:43,760
minerals are precipitated so here's

851
00:31:47,909 --> 00:31:46,240
where the ions would have come in and

852
00:31:50,230 --> 00:31:47,919
minerals with the

853
00:31:52,230 --> 00:31:50,240
inflowing water and some of them may

854
00:31:54,549 --> 00:31:52,240
have been concentrated and perhaps even

855
00:31:57,110 --> 00:31:54,559
trapped some biosignatures

856
00:31:59,509 --> 00:31:57,120
and good analogs on earth in fact some

857
00:32:01,509 --> 00:31:59,519
of the oldest evidence for life on earth

858
00:32:03,590 --> 00:32:01,519
comes from rocks that are

859
00:32:05,830 --> 00:32:03,600
of the same similar composition to these

860
00:32:08,549 --> 00:32:05,840
green rocks they're called carbonates

861
00:32:11,269 --> 00:32:08,559
and if i can have the next slide

862
00:32:13,430 --> 00:32:11,279
some of these rocks look like what

863
00:32:15,750 --> 00:32:13,440

follows they are layered they're made of

864
00:32:18,630 --> 00:32:15,760
carbonate and so what you're looking

865
00:32:20,630 --> 00:32:18,640
here we are back on earth this is a 2.7

866
00:32:22,789 --> 00:32:20,640
billion year old rock a stromatolite

867
00:32:24,950 --> 00:32:22,799
from western australia the area we saw

868
00:32:25,669 --> 00:32:24,960
in ken's video

869
00:32:28,389 --> 00:32:25,679
and

870
00:32:30,789 --> 00:32:28,399
what we know about these rocks is

871
00:32:33,029 --> 00:32:30,799
how to look for bio signatures

872
00:32:35,909 --> 00:32:33,039
so a lot of these little features you

873
00:32:37,990 --> 00:32:35,919
see here different crinkly layers

874
00:32:39,350 --> 00:32:38,000
different little bumps

875
00:32:41,669 --> 00:32:39,360
we know

876
00:32:43,830 --> 00:32:41,679
when microbes have to be involved in the

877
00:32:45,509 --> 00:32:43,840
precipitation of minerals to make shapes

878
00:32:47,990 --> 00:32:45,519
like that so

879
00:32:50,870 --> 00:32:48,000
other stromatolites on mars we don't

880
00:32:53,350 --> 00:32:50,880
know what are these carbonates on mars

881
00:32:55,110 --> 00:32:53,360
we don't know but we are very excited to

882
00:32:57,350 --> 00:32:55,120
start looking at them we certainly have

883
00:32:59,509 --> 00:32:57,360
a great suite of instruments to do so

884
00:33:02,070 --> 00:32:59,519
and we have many sets of trained eyes

885
00:33:04,149 --> 00:33:02,080
that will be ready to simple the best

886
00:33:06,389 --> 00:33:04,159
rocks possible to bring to earth and

887
00:33:08,830 --> 00:33:06,399
start asking these questions about

888
00:33:11,830 --> 00:33:08,840

possibly early life on

889
00:33:13,269 --> 00:33:11,840
mars so with that i will turn it over to

890
00:33:15,430 --> 00:33:13,279
dc

891
00:33:17,750 --> 00:33:15,440
thank you very much tanya i understand

892
00:33:20,549 --> 00:33:17,760
we have some questions from the media on

893
00:33:24,950 --> 00:33:20,559
the phone uh so first question goes to

894
00:33:26,789 --> 00:33:24,960
chelsea good of space.com chelsea

895
00:33:27,990 --> 00:33:26,799
hi thank you so much for taking my

896
00:33:30,789 --> 00:33:28,000
question

897
00:33:32,630 --> 00:33:30,799
um so you know obviously a huge part of

898
00:33:35,750 --> 00:33:32,640
this mission one of its main objectives

899
00:33:38,389 --> 00:33:35,760
is to look for these bio signatures and

900
00:33:40,070 --> 00:33:38,399
evidence of this ancient life

901
00:33:41,029 --> 00:33:40,080
um i'm curious

902
00:33:42,389 --> 00:33:41,039
you know

903
00:33:43,909 --> 00:33:42,399
in part

904
00:33:46,230 --> 00:33:43,919
you know for people who are just like oh

905
00:33:47,430 --> 00:33:46,240
what what does that mean i think

906
00:33:49,590 --> 00:33:47,440
you know obviously we know what bio

907
00:33:52,389 --> 00:33:49,600
signatures are but what are you hoping

908
00:33:54,710 --> 00:33:52,399
to find i guess more concretely we've

909
00:33:56,070 --> 00:33:54,720
seen organics on mars we've seen things

910
00:33:57,750 --> 00:33:56,080
of that nature but i'm curious what

911
00:33:58,630 --> 00:33:57,760
specifically you're looking to see and

912
00:33:59,830 --> 00:33:58,640
then

913
00:34:01,669 --> 00:33:59,840

you know the second part of that

914
00:34:05,269 --> 00:34:01,679
question is i'm curious how you think

915
00:34:07,669 --> 00:34:05,279
people will react um if these findings

916
00:34:10,310 --> 00:34:07,679
if these bio signatures do come to light

917
00:34:12,230 --> 00:34:10,320
and perseverance is able to

918
00:34:18,869 --> 00:34:12,240
take us to the next level in the search

919
00:34:23,109 --> 00:34:21,109
so yeah okay so what are we looking for

920
00:34:25,030 --> 00:34:23,119
what is what is a biosignature and how

921
00:34:26,950 --> 00:34:25,040
are we going to look for it

922
00:34:29,589 --> 00:34:26,960
well the first thing to understand is

923
00:34:31,589 --> 00:34:29,599
that what we are looking for is likely

924
00:34:33,589 --> 00:34:31,599
very primitive life we are not looking

925
00:34:35,669 --> 00:34:33,599
for advanced life forms that might leave

926
00:34:36,790 --> 00:34:35,679
things like bones or

927
00:34:38,470 --> 00:34:36,800
or

928
00:34:40,710 --> 00:34:38,480
fern fossils something like that we are

929
00:34:43,990 --> 00:34:40,720
looking by analogy to what we find in

930
00:34:47,109 --> 00:34:44,000
the similar time on earth microbial life

931
00:34:49,829 --> 00:34:47,119
and tanya showed you an image of a of a

932
00:34:51,750 --> 00:34:49,839
very compelling example from earth of

933
00:34:54,389 --> 00:34:51,760
what that looks like it's a it's

934
00:34:56,790 --> 00:34:54,399
produced where a layer of microbes lives

935
00:34:59,510 --> 00:34:56,800
at the interface between water and mud

936
00:35:01,670 --> 00:34:59,520
at the bottom of a body of water so

937
00:35:03,589 --> 00:35:01,680
that's the kind of feature that we could

938
00:35:05,510 --> 00:35:03,599

we could see with our eyes the the

939
00:35:07,510 --> 00:35:05,520
example that she showed was macroscopic

940
00:35:08,790 --> 00:35:07,520
it was quite large

941
00:35:10,790 --> 00:35:08,800
and if you looked at it with a

942
00:35:13,270 --> 00:35:10,800
microscope which we will be able to do

943
00:35:14,710 --> 00:35:13,280
with the instruments on the on the arm

944
00:35:16,230 --> 00:35:14,720
that i described

945
00:35:18,310 --> 00:35:16,240
you can see that that texture goes right

946
00:35:19,589 --> 00:35:18,320
down to the microscopic scale

947
00:35:21,270 --> 00:35:19,599
and that we would see that there's

948
00:35:23,109 --> 00:35:21,280
organic matter in the terrestrial

949
00:35:25,030 --> 00:35:23,119
analogs that we would hope to see with

950
00:35:25,829 --> 00:35:25,040
the sherlock instrument so that's a

951
00:35:28,230 --> 00:35:25,839
really

952
00:35:30,069 --> 00:35:28,240
that would be a very compelling example

953
00:35:34,069 --> 00:35:30,079
of a biosignature that we might hope to

954
00:35:38,390 --> 00:35:36,069
and i'll just add a little bit towards

955
00:35:40,790 --> 00:35:38,400
the second half of that question which

956
00:35:42,069 --> 00:35:40,800
is even beyond just trying to reach us a

957
00:35:44,390 --> 00:35:42,079
little bit beyond what we hope to

958
00:35:46,150 --> 00:35:44,400
achieve with perseverance we've heard a

959
00:35:47,829 --> 00:35:46,160
lot about the incredible science that we

960
00:35:49,270 --> 00:35:47,839
hope to do at mars in looking for

961
00:35:50,390 --> 00:35:49,280
biosignatures

962
00:35:51,990 --> 00:35:50,400
but we also think there are other

963
00:35:53,829 --> 00:35:52,000

destinations within the solar system

964
00:35:56,230 --> 00:35:53,839
that could also be potential places

965
00:35:58,150 --> 00:35:56,240
where life may have started to take

966
00:36:00,630 --> 00:35:58,160
take hold in the past or may actually be

967
00:36:03,109 --> 00:36:00,640
present even today uh the moons of

968
00:36:05,750 --> 00:36:03,119
jupiter and saturn such as europa uh

969
00:36:08,230 --> 00:36:05,760
europa which is the moon of jupiter uh

970
00:36:09,750 --> 00:36:08,240
titan and enceladus moons of saturn are

971
00:36:11,829 --> 00:36:09,760
also places where there potentially

972
00:36:13,750 --> 00:36:11,839
could be environments that that might be

973
00:36:16,550 --> 00:36:13,760
conducive to life other very interesting

974
00:36:17,829 --> 00:36:16,560
astrobiology targets um and so we're

975
00:36:18,950 --> 00:36:17,839
we're interested in continuing to

976
00:36:21,270 --> 00:36:18,960
explore all of these different

977
00:36:23,270 --> 00:36:21,280
environments mars and beyond uh to

978
00:36:24,790 --> 00:36:23,280
continue our search for are there other

979
00:36:27,829 --> 00:36:24,800
places in the solar system that might

980
00:36:30,470 --> 00:36:27,839
actually host life

981
00:36:32,470 --> 00:36:30,480
great thank you lori uh i understand the

982
00:36:35,349 --> 00:36:32,480
next question is from marcia dunn with

983
00:36:37,510 --> 00:36:35,359
ap marcia

984
00:36:39,589 --> 00:36:37,520
yes hello i have a question for jennifer

985
00:36:41,750 --> 00:36:39,599
trosper if i might

986
00:36:44,710 --> 00:36:41,760
i hate to ask you to choose among your

987
00:36:46,710 --> 00:36:44,720
five rover children but i'm wondering if

988
00:36:47,990 --> 00:36:46,720

first perseverance is your new favorite

989
00:36:51,349 --> 00:36:48,000
child and

990
00:36:54,790 --> 00:36:51,359
also um what do you work with all five

991
00:36:57,910 --> 00:36:54,800
nasa rovers what to you set perseverance

992
00:36:59,510 --> 00:36:57,920
apart the most from its predecessors uh

993
00:37:01,690 --> 00:36:59,520
and you're free to use as many supreme

994
00:37:05,510 --> 00:37:01,700
courts as you'd like thank you

995
00:37:07,589 --> 00:37:05,520
[Laughter]

996
00:37:09,670 --> 00:37:07,599
okay thank you um

997
00:37:11,829 --> 00:37:09,680
so i think i have to first say about the

998
00:37:13,030 --> 00:37:11,839
rovers the same thing i say about my

999
00:37:16,310 --> 00:37:13,040
three children

1000
00:37:18,310 --> 00:37:16,320
they're all my favorites um and i also

1001
00:37:20,790 --> 00:37:18,320
have to be careful because

1002
00:37:23,109 --> 00:37:20,800
i actually met my husband because of the

1003
00:37:25,670 --> 00:37:23,119
pathfinder rover so i i think i have to

1004
00:37:28,710 --> 00:37:25,680
say that one's my favorite um but

1005
00:37:30,550 --> 00:37:28,720
perseverance is also my favorite so i

1006
00:37:32,310 --> 00:37:30,560
don't think i answered your question but

1007
00:37:34,950 --> 00:37:32,320
the thing that i really love about

1008
00:37:36,550 --> 00:37:34,960
perseverance and and i you know i've had

1009
00:37:38,550 --> 00:37:36,560
a different role more of a visionary

1010
00:37:41,270 --> 00:37:38,560
role on perseverance than i had on

1011
00:37:43,430 --> 00:37:41,280
previous rovers so it is more i think a

1012
00:37:46,390 --> 00:37:43,440
part of who i am and what i want rovers

1013
00:37:48,630 --> 00:37:46,400

to be and i see perseverance as being

1014
00:37:50,230 --> 00:37:48,640
transformative right and and i think

1015
00:37:53,109 --> 00:37:50,240
matt talked about it this morning we've

1016
00:37:55,349 --> 00:37:53,119
been exploring we started exploring mars

1017
00:37:57,349 --> 00:37:55,359
with um you know the orbiters and then

1018
00:37:59,829 --> 00:37:57,359
we got to where we had landers and now

1019
00:38:01,829 --> 00:37:59,839
we are driving around and now

1020
00:38:03,750 --> 00:38:01,839
this is transforming us to bringing

1021
00:38:06,710 --> 00:38:03,760
samples back and eventually getting

1022
00:38:08,870 --> 00:38:06,720
humans there so i think that's the thing

1023
00:38:13,030 --> 00:38:08,880
that makes perseverance stand out

1024
00:38:16,310 --> 00:38:13,040
uniquely amongst all of these rovers

1025
00:38:19,829 --> 00:38:16,320
great thank you jennifer uh next up mary

1026
00:38:21,589 --> 00:38:19,839
liz bender with inverse mary

1027
00:38:24,069 --> 00:38:21,599
yeah thank you so much for taking my

1028
00:38:26,630 --> 00:38:24,079
question um i was just curious if you

1029
00:38:29,190 --> 00:38:26,640
could talk about what happens right

1030
00:38:31,990 --> 00:38:29,200
after lunch what do the next steps the

1031
00:38:32,950 --> 00:38:32,000
next couple months look like for you the

1032
00:38:34,230 --> 00:38:32,960
team

1033
00:38:37,109 --> 00:38:34,240
and um

1034
00:38:46,230 --> 00:38:37,119
when will you take your first real fresh

1035
00:38:50,790 --> 00:38:49,109
and that that could go to anyone but uh

1036
00:38:52,790 --> 00:38:50,800
lori perhaps you want to answer that

1037
00:38:54,710 --> 00:38:52,800
question oh

1038
00:38:57,349 --> 00:38:54,720

sure well i'll i'll leave uh some of the

1039
00:38:59,030 --> 00:38:57,359
details of exactly uh what's going to be

1040
00:39:00,950 --> 00:38:59,040
uh happening over the next few months

1041
00:39:03,829 --> 00:39:00,960
maybe to to canon to

1042
00:39:06,069 --> 00:39:03,839
to jennifer but uh you know when will we

1043
00:39:08,870 --> 00:39:06,079
uh heave a sigh of relief i think uh

1044
00:39:11,589 --> 00:39:08,880
after we've uh successfully uh completed

1045
00:39:12,950 --> 00:39:11,599
the entry descent and landing um and and

1046
00:39:15,109 --> 00:39:12,960
gotten through that seven minutes of

1047
00:39:17,270 --> 00:39:15,119
terror i think all of us will be will be

1048
00:39:19,190 --> 00:39:17,280
very relieved and ready to begin the the

1049
00:39:20,550 --> 00:39:19,200
hard work of conducting the surface

1050
00:39:23,510 --> 00:39:20,560
science and starting to see the

1051
00:39:26,069 --> 00:39:23,520
incredible uh results of of the fruits

1052
00:39:27,589 --> 00:39:26,079
of our labor here but i'm gonna let uh

1053
00:39:29,270 --> 00:39:27,599
ken or jennifer talk about what we're

1054
00:39:31,030 --> 00:39:29,280
going to be doing over the next few

1055
00:39:32,550 --> 00:39:31,040
months

1056
00:39:34,710 --> 00:39:32,560
well i'll just say what the science team

1057
00:39:36,790 --> 00:39:34,720
is going to be doing training training

1058
00:39:38,870 --> 00:39:36,800
training it's a very complicated piece

1059
00:39:39,990 --> 00:39:38,880
of hardware and the scientists on this

1060
00:39:41,349 --> 00:39:40,000
mission

1061
00:39:44,069 --> 00:39:41,359
most of them have very little

1062
00:39:45,430 --> 00:39:44,079
preparation to do this kind of work we

1063
00:39:47,430 --> 00:39:45,440

have to understand what the instruments

1064
00:39:49,910 --> 00:39:47,440
are capable of and and how to instruct

1065
00:39:51,349 --> 00:39:49,920
them to do what we want them to do so so

1066
00:39:55,109 --> 00:39:51,359
training is really essential at this

1067
00:39:55,119 --> 00:40:00,470
uh jennifer anything to add from jpl

1068
00:40:05,270 --> 00:40:03,430
yeah i'll add that we have a cruise team

1069
00:40:07,990 --> 00:40:05,280
that is actually flying the vehicle to

1070
00:40:10,230 --> 00:40:08,000
mars so shortly after launch

1071
00:40:12,550 --> 00:40:10,240
we'll actually be able to see the sun on

1072
00:40:14,309 --> 00:40:12,560
our solar arrays and our sun sensors

1073
00:40:16,470 --> 00:40:14,319
we'll be able to find the stars in the

1074
00:40:18,309 --> 00:40:16,480
sky with our star scanner and we'll get

1075
00:40:21,030 --> 00:40:18,319
our attitude initialized we'll get to

1076
00:40:23,030 --> 00:40:21,040
the right spin rate and then um within a

1077
00:40:24,950 --> 00:40:23,040
few weeks we'll do our first trajectory

1078
00:40:27,589 --> 00:40:24,960
correction maneuver which essentially

1079
00:40:29,430 --> 00:40:27,599
just gets us on the home and transfer

1080
00:40:31,670 --> 00:40:29,440
trajectory that we're taking to mars and

1081
00:40:33,270 --> 00:40:31,680
corrects for any launch vehicle um

1082
00:40:34,309 --> 00:40:33,280
errors

1083
00:40:37,030 --> 00:40:34,319
great

1084
00:40:41,829 --> 00:40:37,040
thank you very much jennifer uh next up

1085
00:40:45,430 --> 00:40:41,839
from uh irish television leo enright leo

1086
00:40:49,030 --> 00:40:45,440
uh thanks very much uh dc um for ken

1087
00:40:50,470 --> 00:40:49,040
farley um i rather loved the dotted

1088
00:40:53,430 --> 00:40:50,480

lines

1089
00:40:54,390 --> 00:40:53,440
uh on the traverse uh map that you

1090
00:40:56,790 --> 00:40:54,400
showed

1091
00:40:59,190 --> 00:40:56,800
um could you talk a little bit about the

1092
00:41:00,870 --> 00:40:59,200
extended mission i mean we're all hoping

1093
00:41:03,670 --> 00:41:00,880
you'd go beyond

1094
00:41:06,550 --> 00:41:03,680
uh midway but it looks like at the

1095
00:41:09,750 --> 00:41:06,560
moment you're only prepared to go as far

1096
00:41:11,270 --> 00:41:09,760
as midway or am i reading that map right

1097
00:41:12,630 --> 00:41:11,280
yeah let me let me provide some some

1098
00:41:14,309 --> 00:41:12,640
background here

1099
00:41:15,670 --> 00:41:14,319
during the landing site selection

1100
00:41:17,750 --> 00:41:15,680
process

1101
00:41:20,390 --> 00:41:17,760
the community that was doing the the

1102
00:41:22,950 --> 00:41:20,400
prioritization recognized that jezreel

1103
00:41:25,270 --> 00:41:22,960
crater had some really fantastic targets

1104
00:41:27,750 --> 00:41:25,280
and tanya talked about them the delta

1105
00:41:28,790 --> 00:41:27,760
the carbonate rock very excited to see

1106
00:41:30,630 --> 00:41:28,800
those

1107
00:41:33,910 --> 00:41:30,640
but there was also a great deal of

1108
00:41:36,550 --> 00:41:33,920
excitement to rove up the crater rim and

1109
00:41:38,230 --> 00:41:36,560
explore the highlands beyond which is

1110
00:41:40,870 --> 00:41:38,240
some of the include some of the oldest

1111
00:41:42,950 --> 00:41:40,880
rocks on mars some very unusual features

1112
00:41:45,510 --> 00:41:42,960
that could potentially indicate the

1113
00:41:47,349 --> 00:41:45,520

interaction of hot water with rock

1114
00:41:49,670 --> 00:41:47,359
another habitable environment that we'd

1115
00:41:51,829 --> 00:41:49,680
be very excited to investigate

1116
00:41:53,750 --> 00:41:51,839
but it's important to recognize that we

1117
00:41:56,230 --> 00:41:53,760
have a prime mission that as jennifer

1118
00:41:57,510 --> 00:41:56,240
mentioned is is one mars year and so

1119
00:41:59,430 --> 00:41:57,520
that traverse

1120
00:42:01,349 --> 00:41:59,440
indicates where we hope to get

1121
00:42:07,589 --> 00:42:01,359
by the end of the prime mission about

1122
00:42:13,670 --> 00:42:10,470
great okay uh next up is natalie

1123
00:42:16,390 --> 00:42:13,680
guerrero natalie

1124
00:42:19,349 --> 00:42:16,400
yeah i wanted to know what is the

1125
00:42:21,190 --> 00:42:19,359
process for choosing what samples you

1126
00:42:26,150 --> 00:42:21,200
end up taking because it sounds like

1127
00:42:31,109 --> 00:42:27,510
i can take that one

1128
00:42:33,829 --> 00:42:31,119
we have 43 sample tubes and we expect

1129
00:42:35,349 --> 00:42:33,839
that uh over the entire duration of the

1130
00:42:37,589 --> 00:42:35,359
mission not within the prime mission

1131
00:42:39,910 --> 00:42:37,599
that we will use all of these tubes

1132
00:42:42,710 --> 00:42:39,920
in the pursuit of something like 30 or

1133
00:42:44,550 --> 00:42:42,720
35 really good samples

1134
00:42:46,470 --> 00:42:44,560
the additional tubes are are there so

1135
00:42:48,630 --> 00:42:46,480
that we can for example

1136
00:42:50,069 --> 00:42:48,640
change our minds we we might say oh this

1137
00:42:52,309 --> 00:42:50,079
looks like a good example of some

1138
00:42:53,510 --> 00:42:52,319

particular kind of rock and then six

1139
00:42:56,309 --> 00:42:53,520
months later we find something that's

1140
00:42:58,230 --> 00:42:56,319
much better so we have a ability to kind

1141
00:43:00,870 --> 00:42:58,240
of change our mind in thinking about

1142
00:43:03,030 --> 00:43:00,880
what samples come back

1143
00:43:04,710 --> 00:43:03,040
it's important to understand that

1144
00:43:06,630 --> 00:43:04,720
one of the central goals of the mission

1145
00:43:07,589 --> 00:43:06,640
is to seek the signs of life

1146
00:43:09,270 --> 00:43:07,599
and

1147
00:43:11,589 --> 00:43:09,280
many of the samples that we collect will

1148
00:43:13,670 --> 00:43:11,599
be specifically chosen because they

1149
00:43:16,390 --> 00:43:13,680
represent habitable environments or if

1150
00:43:18,069 --> 00:43:16,400
we are fortunate also have bio potential

1151
00:43:19,670 --> 00:43:18,079
biosignatures in them that we wish to

1152
00:43:21,589 --> 00:43:19,680
investigate further

1153
00:43:22,790 --> 00:43:21,599
but there are also many other kinds of

1154
00:43:25,349 --> 00:43:22,800
questions

1155
00:43:28,069 --> 00:43:25,359
we heard earlier about how mars climate

1156
00:43:29,910 --> 00:43:28,079
changed it changed enormously

1157
00:43:32,870 --> 00:43:29,920
and an important thing to understand is

1158
00:43:34,710 --> 00:43:32,880
that we have no idea why mars was so

1159
00:43:36,390 --> 00:43:34,720
different in its early history and we

1160
00:43:37,750 --> 00:43:36,400
hope that if we bring back rocks and

1161
00:43:39,030 --> 00:43:37,760
study them in terrestrial

1162
00:43:41,510 --> 00:43:39,040
laboratories they'll tell us something

1163
00:43:43,670 --> 00:43:41,520

about that so i guess the idea is that

1164
00:43:45,910 --> 00:43:43,680
we have a broad set of scientific

1165
00:43:48,309 --> 00:43:45,920
objectives that we believe the samples

1166
00:43:50,390 --> 00:43:48,319
can and will be used for and the key

1167
00:43:52,950 --> 00:43:50,400
really is diversity we will collect a

1168
00:43:54,790 --> 00:43:52,960
diversity of samples this reflects not

1169
00:43:56,790 --> 00:43:54,800
only our understanding of what questions

1170
00:43:58,309 --> 00:43:56,800
are likely to be answered but also

1171
00:44:00,150 --> 00:43:58,319
recognizing that

1172
00:44:01,750 --> 00:44:00,160
decades from now there will be many

1173
00:44:04,150 --> 00:44:01,760
other kinds of questions that we can't

1174
00:44:06,390 --> 00:44:04,160
presently foresee so having a diverse

1175
00:44:08,069 --> 00:44:06,400
sample suite is is the best way to

1176
00:44:10,069 --> 00:44:08,079
approach that

1177
00:44:11,670 --> 00:44:10,079
collection of the cash

1178
00:44:13,430 --> 00:44:11,680
great thank you ken

1179
00:44:15,910 --> 00:44:13,440
and we have some questions from social

1180
00:44:17,190 --> 00:44:15,920
media the first one is from tor

1181
00:44:18,950 --> 00:44:17,200
and he is

1182
00:44:21,270 --> 00:44:18,960
in the uk

1183
00:44:22,870 --> 00:44:21,280
and he's been building his own lego and

1184
00:44:24,950 --> 00:44:22,880
connex rover

1185
00:44:27,990 --> 00:44:24,960
for a month and waiting for the launch

1186
00:44:29,430 --> 00:44:28,000
of mars 2020. so he would like to know

1187
00:44:30,710 --> 00:44:29,440
and perhaps tanya this might be a good

1188
00:44:33,349 --> 00:44:30,720

one for you

1189
00:44:38,950 --> 00:44:33,359
how can you fit an entire entire science

1190
00:44:44,309 --> 00:44:41,510
so part part of what makes this

1191
00:44:47,349 --> 00:44:44,319
particular rover so special

1192
00:44:50,470 --> 00:44:47,359
is that we don't have to fit an entire

1193
00:44:53,190 --> 00:44:50,480
science laboratory in this rover for

1194
00:44:55,990 --> 00:44:53,200
example as ken mentioned

1195
00:44:58,069 --> 00:44:56,000
the biosignatures we can look for will

1196
00:45:00,309 --> 00:44:58,079
probably be something microscopic and

1197
00:45:02,870 --> 00:45:00,319
there is just no way to bring a

1198
00:45:05,030 --> 00:45:02,880
microscope a real microscope that we

1199
00:45:06,069 --> 00:45:05,040
would use on earth to the surface of

1200
00:45:07,030 --> 00:45:06,079
mars

1201
00:45:09,190 --> 00:45:07,040
so

1202
00:45:11,270 --> 00:45:09,200
this special rover and its special

1203
00:45:13,109 --> 00:45:11,280
sampling and caching equipment is

1204
00:45:15,829 --> 00:45:13,119
designed to

1205
00:45:18,309 --> 00:45:15,839
store the samples and eventually the

1206
00:45:24,069 --> 00:45:18,319
samples will come to earth and then we

1207
00:45:31,030 --> 00:45:27,030
that said there are there's yeah

1208
00:45:35,030 --> 00:45:33,349
that ken mentioned so there's watson

1209
00:45:37,829 --> 00:45:35,040
there is sherlock there are all these

1210
00:45:40,390 --> 00:45:37,839
instruments that can allow us to look at

1211
00:45:42,470 --> 00:45:40,400
some rock textures and look for some

1212
00:45:43,750 --> 00:45:42,480
organic material

1213
00:45:45,510 --> 00:45:43,760

so

1214
00:45:48,069 --> 00:45:45,520
we can know a lot even just by looking

1215
00:45:50,150 --> 00:45:48,079
at rocks and mars

1216
00:45:52,069 --> 00:45:50,160
thank you tanya uh next question this

1217
00:45:54,950 --> 00:45:52,079
might be a good one for pharah uh

1218
00:45:57,030 --> 00:45:54,960
pharaoh since you're about mobility

1219
00:46:00,790 --> 00:45:57,040
this is a question about keeping camera

1220
00:46:02,390 --> 00:46:00,800
lenses clear of debris and dirt how do

1221
00:46:03,750 --> 00:46:02,400
you do that with the nav cameras that

1222
00:46:07,990 --> 00:46:03,760
are going to be

1223
00:46:12,470 --> 00:46:10,150
so on landing we actually the cameras

1224
00:46:15,109 --> 00:46:12,480
are covered with camera covers which

1225
00:46:16,550 --> 00:46:15,119
protects the cameras from that dust

1226
00:46:18,950 --> 00:46:16,560
so we've tried to keep the cameras as

1227
00:46:21,190 --> 00:46:18,960
clean as we can right now and then after

1228
00:46:22,870 --> 00:46:21,200
the landing sequence will fire we'll

1229
00:46:24,950 --> 00:46:22,880
fire some pyros to get rid of those

1230
00:46:27,349 --> 00:46:24,960
camera covers and that should give us

1231
00:46:29,910 --> 00:46:27,359
really clear vision on mars

1232
00:46:32,550 --> 00:46:29,920
other than that typically we don't tend

1233
00:46:34,870 --> 00:46:32,560
to get too much sand accumulating on the

1234
00:46:37,750 --> 00:46:34,880
cameras that are up on the turret

1235
00:46:39,670 --> 00:46:37,760
so we don't worry too much about that

1236
00:46:41,829 --> 00:46:39,680
and we also benefit sometimes from the

1237
00:46:44,710 --> 00:46:41,839
winds that service cleaning events for

1238
00:46:47,510 --> 00:46:44,720

any dust that might get up there

1239
00:46:49,270 --> 00:46:47,520
great thank you farah the next question

1240
00:46:51,270 --> 00:46:49,280
is from brittany wright

1241
00:46:53,109 --> 00:46:51,280
and brittany wright writes

1242
00:46:55,670 --> 00:46:53,119
i'd love to know what the expected

1243
00:46:57,589 --> 00:46:55,680
lifespan of perseverance is and how you

1244
00:46:59,910 --> 00:46:57,599
go about making repairs to it if

1245
00:47:05,750 --> 00:46:59,920
anything should break or malfunction

1246
00:47:09,510 --> 00:47:06,950
yeah we

1247
00:47:11,750 --> 00:47:09,520
have tested and qualified our hardware

1248
00:47:13,510 --> 00:47:11,760
to one and a half mars years so that's

1249
00:47:15,510 --> 00:47:13,520
longer than the one mars year the two

1250
00:47:17,910 --> 00:47:15,520
earth years that the mission is supposed

1251
00:47:19,349 --> 00:47:17,920
to last the way that we do that we

1252
00:47:21,829 --> 00:47:19,359
actually take it through all the thermal

1253
00:47:23,990 --> 00:47:21,839
cycles the thermal cycles on mars are

1254
00:47:25,430 --> 00:47:24,000
the hardest parts about the hardware

1255
00:47:26,870 --> 00:47:25,440
that could break the hardware and so we

1256
00:47:29,109 --> 00:47:26,880
do that and we make sure that it will

1257
00:47:31,349 --> 00:47:29,119
last through all those thermal cycles

1258
00:47:34,150 --> 00:47:31,359
and we make sure that we our mechanisms

1259
00:47:36,309 --> 00:47:34,160
will move as as many revs as we need

1260
00:47:38,950 --> 00:47:36,319
them to so we've done that

1261
00:47:40,870 --> 00:47:38,960
we expect this to last one mars year now

1262
00:47:42,710 --> 00:47:40,880
the question about what do we do if

1263
00:47:43,750 --> 00:47:42,720

things go wrong is an interesting one

1264
00:47:46,630 --> 00:47:43,760
because

1265
00:47:48,790 --> 00:47:46,640
having operated all of these mars rovers

1266
00:47:51,670 --> 00:47:48,800
there's all kinds of things that

1267
00:47:53,190 --> 00:47:51,680
that just go wrong and it's far away and

1268
00:47:56,150 --> 00:47:53,200
sometimes it doesn't talk to you and

1269
00:47:58,309 --> 00:47:56,160
that's the first problem you notice so

1270
00:47:59,990 --> 00:47:58,319
there are a lot of different methods and

1271
00:48:00,870 --> 00:48:00,000
and a lot of them are in our design

1272
00:48:02,230 --> 00:48:00,880
really

1273
00:48:04,790 --> 00:48:02,240
and i'll just talk to a couple of them

1274
00:48:06,630 --> 00:48:04,800
the first one is that we have redundancy

1275
00:48:09,030 --> 00:48:06,640
in our critical hardware so if the

1276
00:48:11,589 --> 00:48:09,040
flight computer goes bad we have another

1277
00:48:13,109 --> 00:48:11,599
flight computer that can replace it we

1278
00:48:16,470 --> 00:48:13,119
also have something called functional

1279
00:48:18,150 --> 00:48:16,480
redundancy where we have for example we

1280
00:48:20,549 --> 00:48:18,160
can talk directly to the rover from

1281
00:48:22,309 --> 00:48:20,559
earth via uplink and sending it commands

1282
00:48:24,710 --> 00:48:22,319
but we can also send those commands

1283
00:48:27,109 --> 00:48:24,720
through orbiters if for some reason we

1284
00:48:29,670 --> 00:48:27,119
lose the link to the rover um from

1285
00:48:32,150 --> 00:48:29,680
direct to earth so we have those types

1286
00:48:34,630 --> 00:48:32,160
of things it's always harrowing when you

1287
00:48:37,030 --> 00:48:34,640
don't hear from the rover some of some

1288
00:48:39,430 --> 00:48:37,040

great stories about um getting these

1289
00:48:41,589 --> 00:48:39,440
rovers out of difficult situations but

1290
00:48:44,549 --> 00:48:41,599
the the team of operations personnel are

1291
00:48:46,829 --> 00:48:44,559
very well experienced and suited to to

1292
00:48:49,589 --> 00:48:46,839
help the rover whenever it has some

1293
00:48:51,750 --> 00:48:49,599
problems great thank you jennifer and

1294
00:48:53,990 --> 00:48:51,760
actually one more question for you and

1295
00:48:56,390 --> 00:48:54,000
this one's from michael jackal and he

1296
00:49:02,150 --> 00:48:56,400
writes what is the hardest part about

1297
00:49:07,270 --> 00:49:04,870
well perseverance is a very complicated

1298
00:49:09,829 --> 00:49:07,280
rover i think and i showed you different

1299
00:49:11,750 --> 00:49:09,839
pieces of it during my presentation uh

1300
00:49:13,829 --> 00:49:11,760
the hardest part of this rover there are

1301
00:49:16,710 --> 00:49:13,839
many parts that are hard but the the

1302
00:49:19,750 --> 00:49:16,720
sampling and caching system is a

1303
00:49:21,589 --> 00:49:19,760
robotically complex system you have to

1304
00:49:23,030 --> 00:49:21,599
hand samples back and forth between

1305
00:49:25,750 --> 00:49:23,040
different robot arms through a big

1306
00:49:28,790 --> 00:49:25,760
carousel and then on top of that it has

1307
00:49:30,790 --> 00:49:28,800
to be super clean so that whatever you

1308
00:49:32,549 --> 00:49:30,800
discover is not something that you took

1309
00:49:34,710 --> 00:49:32,559
with you because it wasn't clean enough

1310
00:49:36,470 --> 00:49:34,720
when you launched it so that has been

1311
00:49:38,710 --> 00:49:36,480
the hardest thing to develop on the

1312
00:49:41,109 --> 00:49:38,720
perseverance rover and it's really i

1313
00:49:43,190 --> 00:49:41,119

think a real testament that we the team

1314
00:49:44,790 --> 00:49:43,200
has been able to get that and get that

1315
00:49:47,190 --> 00:49:44,800
to the point where we can collect these

1316
00:49:49,109 --> 00:49:47,200
samples and launch in the 2020 launch

1317
00:49:49,829 --> 00:49:49,119
window

1318
00:49:51,670 --> 00:49:49,839
great

1319
00:49:52,309 --> 00:49:51,680
thank you jennifer well we're coming up

1320
00:49:53,750 --> 00:49:52,319
at

1321
00:49:56,630 --> 00:49:53,760
the top of the hour soon so it's

1322
00:49:58,710 --> 00:49:56,640
probably a good time to wrap the show a

1323
00:50:00,790 --> 00:49:58,720
reminder that tomorrow we have two more

1324
00:50:02,870 --> 00:50:00,800
briefings about the march 2020

1325
00:50:05,430 --> 00:50:02,880
perseverance rover mission uh the first

1326
00:50:06,870 --> 00:50:05,440
one's at 2 p.m eastern and that's on

1327
00:50:08,790 --> 00:50:06,880
sample return

1328
00:50:11,109 --> 00:50:08,800
uh that should be a real good one and

1329
00:50:13,750 --> 00:50:11,119
then two hours later at 4 pm eastern we

1330
00:50:15,349 --> 00:50:13,760
have one on march 2020 mission tech and

1331
00:50:17,910 --> 00:50:15,359
humans to mars

1332
00:50:20,390 --> 00:50:17,920
so those are two good media briefings

1333
00:50:22,870 --> 00:50:20,400
tomorrow a reminder of course that july

1334
00:50:25,670 --> 00:50:22,880
30th is the opening of our launch period

1335
00:50:29,510 --> 00:50:25,680
and commentary will start on july 30 at

1336
00:50:31,430 --> 00:50:29,520
7 00 am and 7 50 a.m is the first

1337
00:50:33,109 --> 00:50:31,440
opportunity for launch that day

1338
00:50:34,790 --> 00:50:33,119

don't forget to follow the mission on

1339
00:50:38,230 --> 00:50:34,800
social media at

1340
00:50:40,150 --> 00:50:38,240
nasa persevere on twitter and facebook

1341
00:50:42,670 --> 00:50:40,160
and please feel free to join the

1342
00:50:44,950 --> 00:50:42,680
conversation using the hashtag

1343
00:50:47,750 --> 00:50:44,960
poundcountdown to mars

1344
00:50:49,349 --> 00:50:47,760
so that's it from here at ksc press site