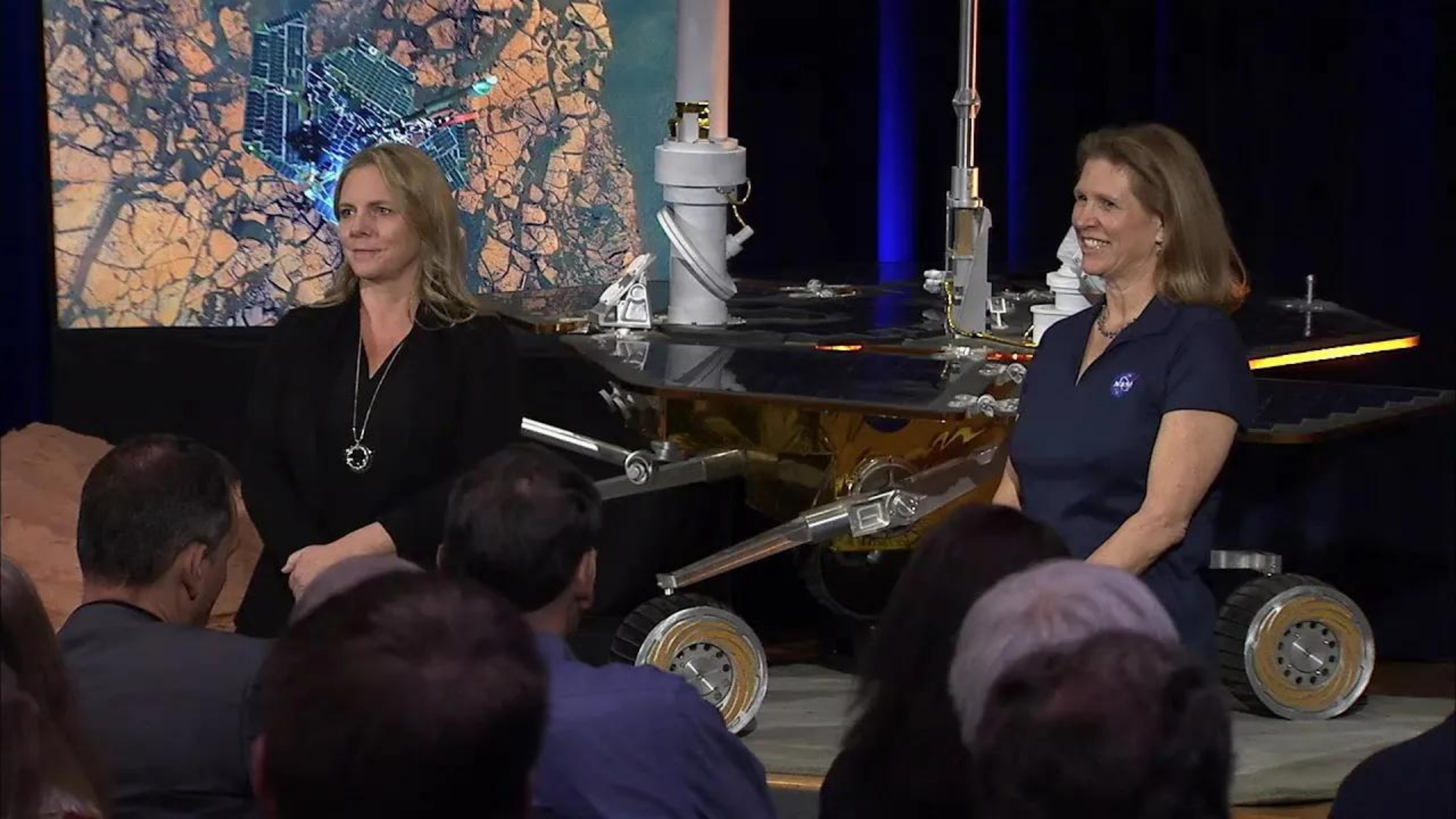

1
00:00:04,970 --> 00:00:21,070
[Music]

2
00:00:27,769 --> 00:00:24,560
hello everyone I'm je Hill and welcome

3
00:00:30,470 --> 00:00:27,779
to NASA's Jet Propulsion Laboratory I am

4
00:00:33,549 --> 00:00:30,480
standing in the historic von Karman

5
00:00:36,340 --> 00:00:33,559
auditorium this is where JPL has

6
00:00:40,190 --> 00:00:36,350
historically released its news on

7
00:00:43,639 --> 00:00:40,200
Voyager on Cassini and today on one of

8
00:00:47,240 --> 00:00:43,649
our Mars rovers now the day that

9
00:00:50,090 --> 00:00:47,250
opportunity landed it was 15 years ago

10
00:00:52,850 --> 00:00:50,100
believe it or not this place was packed

11
00:00:55,910 --> 00:00:52,860
full of reporters and members of the

12
00:00:58,819 --> 00:00:55,920
team and today it is packed again with

13
00:01:01,279 --> 00:00:58,829

many of the people back for today's news

14
00:01:03,170 --> 00:01:01,289
and it's been actually fabulous and

15
00:01:06,109 --> 00:01:03,180
wonderful to see everybody together

16
00:01:09,620 --> 00:01:06,119
again now everybody probably knows by

17
00:01:11,179 --> 00:01:09,630
now that NASA's opportunity went silent

18
00:01:14,899 --> 00:01:11,189
on June 10th

19
00:01:17,870 --> 00:01:14,909
that's after a massive global dust storm

20
00:01:20,630 --> 00:01:17,880
just covered the planet and the skies

21
00:01:21,859 --> 00:01:20,640
darkened and the rover could not get

22
00:01:25,100 --> 00:01:21,869
solar power

23
00:01:27,560 --> 00:01:25,110
last night the team made its final

24
00:01:30,319 --> 00:01:27,570
planned commands and we have some video

25
00:01:32,660 --> 00:01:30,329
to show you right here at the time part

26
00:01:36,109 --> 00:01:32,670
of the team went up to Mission Control

27
00:01:39,200 --> 00:01:36,119
to send up more commands to ask the

28
00:01:42,200 --> 00:01:39,210
rover to respond one-way light time is

29
00:01:44,420 --> 00:01:42,210
about 13 and a half minutes it took 13

30
00:01:47,660 --> 00:01:44,430
and a half minutes to get a signal up to

31
00:01:49,850 --> 00:01:47,670
Mars and if the rover did respond it

32
00:01:52,490 --> 00:01:49,860
would take another 13 and a half minutes

33
00:01:55,399 --> 00:01:52,500
to come back to find out more and what

34
00:01:57,139 --> 00:01:55,409
the outcome was from last night I'd like

35
00:02:00,469 --> 00:01:57,149
to introduce you to the panel right now

36
00:02:03,080 --> 00:02:00,479
we begin with introductions our JPL

37
00:02:06,649 --> 00:02:03,090
director Mike Watkins the NASA

38
00:02:08,540 --> 00:02:06,659

Administrator Jim bridenstine and also

39
00:02:11,180 --> 00:02:08,550
the associate

40
00:02:12,140 --> 00:02:11,190
administrator Thomas's are Buchan Thomas

41
00:02:14,690 --> 00:02:12,150
we'll start with you

42
00:02:17,450 --> 00:02:14,700
thank you so much I was there yesterday

43
00:02:20,900 --> 00:02:17,460
and I was there with the team as these

44
00:02:24,680 --> 00:02:20,910
commands went out into the deep sky and

45
00:02:28,400 --> 00:02:24,690
I learned this morning that we had not

46
00:02:30,160 --> 00:02:28,410
heard back and our beloved opportunity

47
00:02:34,420 --> 00:02:30,170
remained silent

48
00:02:38,990 --> 00:02:34,430
it is therefore that I'm standing here

49
00:02:42,560 --> 00:02:39,000
with a sense of deep appreciation and

50
00:02:45,920 --> 00:02:42,570
gratitude that I declare the opportunity

51
00:02:49,480 --> 00:02:45,930
mission is complete and with it the mars

52
00:02:53,900 --> 00:02:49,490
exploration rover mission is complete I

53
00:02:55,520 --> 00:02:53,910
stand here surrounded by the team and I

54
00:02:58,550 --> 00:02:55,530
have to tell you that's an emotional

55
00:03:01,820 --> 00:02:58,560
time I stand here surrounded by team

56
00:03:05,150 --> 00:03:01,830
that I before I even came to NASA I got

57
00:03:08,360 --> 00:03:05,160
to know as I watched this amazing entry

58
00:03:10,490 --> 00:03:08,370
descent and landing D and development

59
00:03:11,360 --> 00:03:10,500
and of course at the center of that were

60
00:03:13,430 --> 00:03:11,370
two people

61
00:03:16,460 --> 00:03:13,440
Pete ty singer was right here ahead of

62
00:03:25,559 --> 00:03:16,470
me he's a hero in the world that we live

63
00:03:30,330 --> 00:03:28,949

and right next to me right here as Steve

64
00:03:40,540 --> 00:03:30,340
Squyres you can no meet them later

65
00:03:48,140 --> 00:03:45,200
and surrounded by a team it's a team

66
00:03:50,690 --> 00:03:48,150
that makes success like this it's a team

67
00:03:52,850 --> 00:03:50,700
that creates exploration transformative

68
00:03:55,190 --> 00:03:52,860
exploration for signs and engineering

69
00:03:57,110 --> 00:03:55,200
and it's a team that is celebrating here

70
00:03:58,660 --> 00:03:57,120
today emotionally I remember the

71
00:04:00,650 --> 00:03:58,670
emotions I saw that Cornell professor

72
00:04:04,070 --> 00:04:00,660
jumping up and down like my

73
00:04:05,870 --> 00:04:04,080
four-year-old at his birthday when when

74
00:04:09,620 --> 00:04:05,880
entry descent and landing was complete

75
00:04:12,020 --> 00:04:09,630
and the rower said I'm here and we're

76
00:04:14,030 --> 00:04:12,030
celebrating with emotions science is an

77
00:04:16,930 --> 00:04:14,040
emotional affair it's a team sport and

78
00:04:19,970 --> 00:04:16,940
that's what we're celebrating today I

79
00:04:21,560 --> 00:04:19,980
will never forget the amazing work that

80
00:04:23,630 --> 00:04:21,570
happened here it transformed our

81
00:04:26,330 --> 00:04:23,640
understanding of our planet everything

82
00:04:28,730 --> 00:04:26,340
we do and think about in our planetary

83
00:04:30,950 --> 00:04:28,740
neighborhood with Mars and elsewhere

84
00:04:32,900 --> 00:04:30,960
relates to the research that came from

85
00:04:34,880 --> 00:04:32,910
that and the engineering breakthroughs

86
00:04:37,010 --> 00:04:34,890
that came from that and it's really a

87
00:04:39,350 --> 00:04:37,020
great honor right now to introduce a

88
00:04:41,810 --> 00:04:39,360

champion for exploration and for science

89
00:04:44,690 --> 00:04:41,820
the administrator you know bridenstine

90
00:04:47,870 --> 00:04:44,700
well thank you thank you so much Thomas

91
00:04:51,560 --> 00:04:47,880
it's it's an honor to be here I want to

92
00:04:54,409 --> 00:04:51,570
say almost two decades worth of work by

93
00:04:56,930 --> 00:04:54,419
so many extraordinarily impressive

94
00:04:58,940 --> 00:04:56,940
people in this room right now and then

95
00:05:00,800 --> 00:04:58,950
last year I became the administrator an

96
00:05:02,780 --> 00:05:00,810
opportunity quit communicating can you

97
00:05:06,680 --> 00:05:02,790
believe that so I take full

98
00:05:09,469 --> 00:05:06,690
responsibility but because I'm a

99
00:05:11,270 --> 00:05:09,479
politician historically I will go ahead

100
00:05:13,100 --> 00:05:11,280
and pass that responsibility to somebody

101
00:05:16,370 --> 00:05:13,110
else I don't know yet but I'll figure

102
00:05:20,210 --> 00:05:16,380
out who that is but this is a

103
00:05:22,969 --> 00:05:20,220
celebration of so many achievements and

104
00:05:26,060 --> 00:05:22,979
I'll just start by saying you know when

105
00:05:30,260 --> 00:05:26,070
this little rover landed the objective

106
00:05:35,480 --> 00:05:30,270
was to have it be able to move 1,100

107
00:05:40,010 --> 00:05:35,490
yards and survive for 90 days on Mars 90

108
00:05:44,120 --> 00:05:40,020
Souls and instead here we are 14 years

109
00:05:45,710 --> 00:05:44,130
later after 28 miles of travel and today

110
00:05:48,529 --> 00:05:45,720
we get to celebrate the end of this

111
00:05:50,480 --> 00:05:48,539
mission so it's it's an honor for me as

112
00:05:52,850 --> 00:05:50,490
the NASA Administrator to come out here

113
00:05:53,650 --> 00:05:52,860

to this amazing facility with so many

114
00:05:56,260 --> 00:05:53,660
amazing

115
00:05:59,290 --> 00:05:56,270
mainly talented people to say thank you

116
00:06:01,510 --> 00:05:59,300
for your great work not just for our

117
00:06:03,640 --> 00:06:01,520
country but for the science that people

118
00:06:05,020 --> 00:06:03,650
are going to be benefitting all over the

119
00:06:07,210 --> 00:06:05,030
world they're gonna be benefiting from

120
00:06:09,280 --> 00:06:07,220
this science for years to come and so

121
00:06:11,380 --> 00:06:09,290
now I'd like to take the opportunity to

122
00:06:14,440 --> 00:06:11,390
introduce the director of the Jet

123
00:06:16,660 --> 00:06:14,450
Propulsion Laboratory Mike Watkins thank

124
00:06:19,030 --> 00:06:16,670
you Jim spirit and opportunity may be

125
00:06:21,430 --> 00:06:19,040
gone but they leave us a legacy and

126
00:06:24,160 --> 00:06:21,440
that's a legacy of a new paradigm for

127
00:06:26,830 --> 00:06:24,170
solar system exploration a robotic

128
00:06:28,630 --> 00:06:26,840
geologist on Mars and an integrated

129
00:06:31,270 --> 00:06:28,640
science and engineering operations team

130
00:06:33,010 --> 00:06:31,280
here on earth all set out together on a

131
00:06:34,240 --> 00:06:33,020
mission of discovery they didn't know

132
00:06:35,890 --> 00:06:34,250
what they would find they didn't know

133
00:06:38,080 --> 00:06:35,900
which direction they would go sometimes

134
00:06:39,990 --> 00:06:38,090
from one day to the next and they made

135
00:06:42,790 --> 00:06:40,000
it work and they made it work longer

136
00:06:44,470 --> 00:06:42,800
than any of us thought possible by both

137
00:06:46,180 --> 00:06:44,480
brilliant scientific deduction of where

138
00:06:48,850 --> 00:06:46,190

to go and brilliant engineering to keep

139
00:06:51,130 --> 00:06:48,860
the Rovers alive and that legacy

140
00:06:52,150 --> 00:06:51,140
continues not just in the Curiosity

141
00:06:55,360 --> 00:06:52,160
rover which is currently operating

142
00:06:57,610 --> 00:06:55,370
healthily on Mars after about 2300 days

143
00:06:59,440 --> 00:06:57,620
on the surface of Mars but also in our

144
00:07:01,120 --> 00:06:59,450
new 2020 Rover which is under

145
00:07:04,450 --> 00:07:01,130
construction here at the Jet Propulsion

146
00:07:05,260 --> 00:07:04,460
Laboratory but certain opportunity did

147
00:07:08,710 --> 00:07:05,270
something more than that

148
00:07:11,470 --> 00:07:08,720
they energized the public about the

149
00:07:14,020 --> 00:07:11,480
spirit of robotic Mars exploration they

150
00:07:16,330 --> 00:07:14,030
brought to life these will two little

151
00:07:18,670 --> 00:07:16,340
intrepid Rovers and an incredibly

152
00:07:20,890 --> 00:07:18,680
energetic and dedicated ground team and

153
00:07:23,280 --> 00:07:20,900
the energy the infectious energy and

154
00:07:26,010 --> 00:07:23,290
electricity that this mission created

155
00:07:28,930 --> 00:07:26,020
was obvious to the public and that

156
00:07:30,490 --> 00:07:28,940
legacy turns out not only in a

157
00:07:33,460 --> 00:07:30,500
generation of engineers and scientists

158
00:07:35,590 --> 00:07:33,470
of which I am one but also a generation

159
00:07:37,930 --> 00:07:35,600
of students many students were inspired

160
00:07:39,790 --> 00:07:37,940
to go into STEM careers and a few of

161
00:07:42,940 --> 00:07:39,800
them actually to come here to JPL to

162
00:07:44,650 --> 00:07:42,950
work on this mission opportunity now you

163
00:07:47,200 --> 00:07:44,660

will hear a lot more about these two

164
00:07:48,460 --> 00:07:47,210
legacies in the upcoming panels and to

165
00:07:51,460 --> 00:07:48,470
get that started I'll turn it back to

166
00:07:53,620 --> 00:07:51,470
gey hill all right thanks Mike and we

167
00:07:55,600 --> 00:07:53,630
would like to add that we will be taking

168
00:07:58,420 --> 00:07:55,610
questions later on the program at the

169
00:07:59,350 --> 00:07:58,430
end of all our panels so if you are on

170
00:08:02,110 --> 00:07:59,360
the telephone

171
00:08:03,880 --> 00:08:02,120
be sure to hit star one to get yourself

172
00:08:05,660 --> 00:08:03,890
in the queue if you have a question on

173
00:08:09,410 --> 00:08:05,670
social media you

174
00:08:10,910 --> 00:08:09,420
hashtag ask NASA all right so let's tell

175
00:08:13,700 --> 00:08:10,920
you a little bit about our Rover

176
00:08:16,250 --> 00:08:13,710
opportunity if there were a word to

177
00:08:18,860 --> 00:08:16,260
describe this Rover it would be an

178
00:08:22,790 --> 00:08:18,870
overachiever now think about it it was

179
00:08:25,760 --> 00:08:22,800
only supposed to go 90 days it went 14

180
00:08:28,510 --> 00:08:25,770
and a half years and from it we learned

181
00:08:31,760 --> 00:08:28,520
a wealth of science and also how to

182
00:08:45,010 --> 00:08:31,770
explore with that way give you this

183
00:08:50,300 --> 00:08:47,720
opportunity hit a hole-in-one when she

184
00:08:51,320 --> 00:08:50,310
landed the airbag system rolled into the

185
00:08:53,840 --> 00:08:51,330
small crater called

186
00:08:56,240 --> 00:08:53,850
Eagle crater and when the rover first

187
00:08:58,190 --> 00:08:56,250
turned on its cameras it saw that the

188
00:09:00,350 --> 00:08:58,200

rim of the small crater was lined with

189
00:09:01,880 --> 00:09:00,360
exposed bedrock so we took out our

190
00:09:03,950 --> 00:09:01,890
microscope for the first time and we

191
00:09:05,780 --> 00:09:03,960
took a picture and the surface of Mars

192
00:09:08,150 --> 00:09:05,790
at that location is littered with an

193
00:09:09,890 --> 00:09:08,160
uncountable number of little round thing

194
00:09:11,570 --> 00:09:09,900
that we're called blueberries because

195
00:09:14,360 --> 00:09:11,580
they looked like blueberries in a muffin

196
00:09:16,910 --> 00:09:14,370
what we discovered was that those are

197
00:09:18,769 --> 00:09:16,920
features that form in water and and they

198
00:09:20,930 --> 00:09:18,779
were a really definitive sign that there

199
00:09:24,079 --> 00:09:20,940
had been liquid water on the surface of

200
00:09:25,519 --> 00:09:24,089
Mars sometime in the past you know after

201
00:09:27,710 --> 00:09:25,529
we left Eagle crater we went to

202
00:09:30,590 --> 00:09:27,720
endurance crater and that's the crater

203
00:09:32,450 --> 00:09:30,600
we drove down in and there we did with

204
00:09:34,340 --> 00:09:32,460
the geologists call and in sequence

205
00:09:36,350 --> 00:09:34,350
stratigraphic section which is

206
00:09:38,090 --> 00:09:36,360
essentially reading the chapters of the

207
00:09:40,880 --> 00:09:38,100
Martian history book in reverse order

208
00:09:45,380 --> 00:09:40,890
that Rover became a stratigraphy first

209
00:09:48,050 --> 00:09:45,390
time you had a stratigraphy on Mars we

210
00:09:50,630 --> 00:09:48,060
knew we wanted to go after endurance to

211
00:09:52,310 --> 00:09:50,640
Victoria we put pedal to the metal and

212
00:09:54,920 --> 00:09:52,320
we started heading there tens of

213
00:09:58,070 --> 00:09:54,930

kilometers away we had to literally surf

214
00:10:00,350 --> 00:09:58,080
across these dunes of windblown material

215
00:10:03,860 --> 00:10:00,360
and the rover got stuck in one of those

216
00:10:05,780 --> 00:10:03,870
we had to get the rover unstuck what we

217
00:10:08,810 --> 00:10:05,790
found is the best way to get it out is

218
00:10:10,670 --> 00:10:08,820
just to put it in reverse and gun it the

219
00:10:12,590 --> 00:10:10,680
rover eventually popped out and so we

220
00:10:16,700 --> 00:10:12,600
changed our driving strategy so we

221
00:10:19,400 --> 00:10:16,710
recognize these ripples as hazards we

222
00:10:22,100 --> 00:10:19,410
get to this giant half-mile diameter

223
00:10:24,079 --> 00:10:22,110
crater Victoria crater and we want to

224
00:10:25,640 --> 00:10:24,089
figure out gee how can we go into this

225
00:10:28,190 --> 00:10:25,650
thing all of a sudden we got high-rise

226
00:10:30,350 --> 00:10:28,200
images we could see the rover in the

227
00:10:33,290 --> 00:10:30,360
image that was the very first image that

228
00:10:37,040 --> 00:10:33,300
we got from space showing one of our

229
00:10:39,500 --> 00:10:37,050
Rovers we spent a year scouting the edge

230
00:10:41,810 --> 00:10:39,510
of that crater to decide where we wanted

231
00:10:44,750 --> 00:10:41,820
to go in to get the best stratigraphic

232
00:10:47,030 --> 00:10:44,760
section we found a place to go in and we

233
00:10:50,240 --> 00:10:47,040
drove down in and we spent about a year

234
00:10:52,329 --> 00:10:50,250
inside Victoria crater the science team

235
00:10:54,879 --> 00:10:52,339
was really excited about the idea of

236
00:10:57,100 --> 00:10:54,889
to Endeavour crater over 20 kilometers

237
00:10:59,319 --> 00:10:57,110
away is a long drive to do it was gonna

238
00:11:01,629 --> 00:10:59,329

take multiple years but they decided to

239
00:11:03,790 --> 00:11:01,639
do it anyways there were too many of

240
00:11:06,220 --> 00:11:03,800
these dangerous ripples in our way and

241
00:11:08,829 --> 00:11:06,230
we actually had to take this secure this

242
00:11:11,139 --> 00:11:08,839
route that at times took us away from

243
00:11:13,540 --> 00:11:11,149
the crater only to then cut back and

244
00:11:14,920 --> 00:11:13,550
then approach it more directly and then

245
00:11:16,179 --> 00:11:14,930
we pull up to endeavour crater and all

246
00:11:18,850 --> 00:11:16,189
of a sudden there's all these new things

247
00:11:21,519 --> 00:11:18,860
to look at we first discovered the

248
00:11:24,280 --> 00:11:21,529
Homestake vein it was this very very

249
00:11:26,799 --> 00:11:24,290
bright linear feature it turns out that

250
00:11:29,410 --> 00:11:26,809
there was a big gypsum vein and we see

251
00:11:31,030 --> 00:11:29,420
these gypsum veins now all over so it

252
00:11:33,610 --> 00:11:31,040
was our first taste of what is a really

253
00:11:36,670 --> 00:11:33,620
important process on Mars we were

254
00:11:38,259 --> 00:11:36,680
driving to a valley and along the way

255
00:11:39,369 --> 00:11:38,269
there we realized that right about the

256
00:11:40,689 --> 00:11:39,379
point where we were about to get to this

257
00:11:42,699 --> 00:11:40,699
valley that was when we were gonna cross

258
00:11:43,749 --> 00:11:42,709
the marathon mark so we said well that's

259
00:11:45,340 --> 00:11:43,759
cool we're just going to name this

260
00:11:47,410 --> 00:11:45,350
valley after that call it marathon

261
00:11:50,170 --> 00:11:47,420
Valley that was when we reached the

262
00:11:52,540 --> 00:11:50,180
distance of a marathon 26.2 miles on

263
00:11:54,369 --> 00:11:52,550

another planet we continued driving

264
00:11:57,069 --> 00:11:54,379
through some slopes down a little bit on

265
00:11:58,509 --> 00:11:57,079
the interior of the crater rim until we

266
00:12:00,429 --> 00:11:58,519
came back out so that we could continue

267
00:12:02,829 --> 00:12:00,439
on to the next Valley perserverance

268
00:12:05,919 --> 00:12:02,839
valley where the rover was exploring

269
00:12:08,230 --> 00:12:05,929
when we lost contact we said we're gonna

270
00:12:10,269 --> 00:12:08,240
operate this vehicle until the day where

271
00:12:12,639 --> 00:12:10,279
we can't and that's exactly what we did

272
00:12:14,980 --> 00:12:12,649
and I'm really proud we've set a

273
00:12:17,140 --> 00:12:14,990
foundation that will serve as the basis

274
00:12:30,610 --> 00:12:17,150
for future exploration

275
00:12:36,559 --> 00:12:33,860
well opportunity would not have had that

276
00:12:38,989 --> 00:12:36,569
longevity had it not been the engineers

277
00:12:41,809 --> 00:12:38,999
that built it and the engineers that

278
00:12:45,439 --> 00:12:41,819
kept it going they took the word work

279
00:12:48,499 --> 00:12:45,449
around to a whole new level so let me

280
00:12:51,470 --> 00:12:48,509
introduce you to project manager John

281
00:13:00,980 --> 00:12:51,480
Kallis and deputy project scientist

282
00:13:04,579 --> 00:13:00,990
Abigail Freeman thanks gaying good

283
00:13:06,889 --> 00:13:04,589
morning we were meant to get to this

284
00:13:09,139 --> 00:13:06,899
point you know to where these Rovers out

285
00:13:11,210 --> 00:13:09,149
to leave behind no unutilized capability

286
00:13:14,960 --> 00:13:11,220
on the surface of Mars we had no idea

287
00:13:17,720 --> 00:13:14,970
would take this long but even still this

288
00:13:19,819 --> 00:13:17,730

is a hard day and this is hard for me

289
00:13:22,460 --> 00:13:19,829
because I was there at the beginning and

290
00:13:23,989 --> 00:13:22,470
I remember during the early days of

291
00:13:26,420 --> 00:13:23,999
development we were trying to finish up

292
00:13:28,489 --> 00:13:26,430
the construction of the Rovers in the

293
00:13:30,559 --> 00:13:28,499
cleanroom just a few feet away from here

294
00:13:32,689 --> 00:13:30,569
that we were working three shifts and

295
00:13:34,970 --> 00:13:32,699
the engineering team was working the

296
00:13:37,579 --> 00:13:34,980
first two chefs and they had a one

297
00:13:40,280 --> 00:13:37,589
person who would keep a skeleton chef

298
00:13:42,470 --> 00:13:40,290
for the Rovers from 7p Alex Rooney 11

299
00:13:44,059 --> 00:13:42,480
p.m. to 7:00 a.m. and I volunteered to

300
00:13:45,350 --> 00:13:44,069
take many of those shifts typically on

301
00:13:48,019 --> 00:13:45,360
the weekend when it was hard to find

302
00:13:49,730 --> 00:13:48,029
someone and it was very meaningful it's

303
00:13:51,319 --> 00:13:49,740
very touching because it was just me

304
00:13:53,269 --> 00:13:51,329
with the two Rovers so the Rovers were

305
00:13:56,179 --> 00:13:53,279
in the cleanroom like it was a neonatal

306
00:13:57,769 --> 00:13:56,189
care facility and they had all the

307
00:13:59,869 --> 00:13:57,779
life-support equipment and you would

308
00:14:01,340 --> 00:13:59,879
watch their vital signs and you would

309
00:14:03,259 --> 00:14:01,350
see their heart rates and you would see

310
00:14:04,730 --> 00:14:03,269
the voltages and temperatures and

311
00:14:06,889 --> 00:14:04,740
currents and they would be living and

312
00:14:08,809 --> 00:14:06,899
you would see them awake and sleep and

313
00:14:11,509 --> 00:14:08,819

so during those times when it was just

314
00:14:15,079 --> 00:14:11,519
me you know you develop a special bond

315
00:14:16,519 --> 00:14:15,089
and they become your children and that

316
00:14:19,610 --> 00:14:16,529
theme I think it's true for so many

317
00:14:22,400 --> 00:14:19,620
people here tonight are today that they

318
00:14:24,559 --> 00:14:22,410
they have that strong connection so even

319
00:14:27,259 --> 00:14:24,569
though it's a machine and we're saying

320
00:14:27,919 --> 00:14:27,269
goodbye it's still very hard and very

321
00:14:30,290 --> 00:14:27,929
poignant

322
00:14:35,269 --> 00:14:30,300
but we had to do that we came to that

323
00:14:39,289 --> 00:14:35,279
point so what happened well back in June

324
00:14:41,179 --> 00:14:39,299
we were afflicted by a historic global

325
00:14:42,480 --> 00:14:41,189
dust storm on Mars to just blacken the

326
00:14:44,519 --> 00:14:42,490
skies over the Rover

327
00:14:46,769 --> 00:14:44,529
and starve the rover for energy and the

328
00:14:49,290 --> 00:14:46,779
rover went silent and we tried valiantly

329
00:14:50,880 --> 00:14:49,300
over these last eight months to try to

330
00:14:53,460 --> 00:14:50,890
recover the rover to get some signal

331
00:14:54,990 --> 00:14:53,470
from it we've listened every single day

332
00:14:57,180 --> 00:14:55,000
with the Deep Space Network where their

333
00:14:59,430 --> 00:14:57,190
sensitive receivers and we sent over a

334
00:15:02,430 --> 00:14:59,440
thousand recovery commands trying to

335
00:15:05,190 --> 00:15:02,440
exercise every possibility of getting a

336
00:15:06,810 --> 00:15:05,200
signal from the rover but with time the

337
00:15:09,920 --> 00:15:06,820
skies are darkening it's getting colder

338
00:15:12,720 --> 00:15:09,930

on Mars we recently passed through the

339
00:15:13,920 --> 00:15:12,730
historic dust cleaning season on Mars to

340
00:15:15,780 --> 00:15:13,930
see if that would help

341
00:15:17,519 --> 00:15:15,790
but that brought us to today or brought

342
00:15:20,160 --> 00:15:17,529
us through last night we set our final

343
00:15:24,060 --> 00:15:20,170
commands and we heard nothing and so it

344
00:15:26,310 --> 00:15:24,070
comes time to say goodbye but we want to

345
00:15:28,620 --> 00:15:26,320
remember the 14 and a half years of

346
00:15:30,510 --> 00:15:28,630
phenomenal exploration you know this was

347
00:15:32,760 --> 00:15:30,520
a 90-day mission and we were so excited

348
00:15:34,889 --> 00:15:32,770
by just having three months to to

349
00:15:37,530 --> 00:15:34,899
explore the planet with just a kilometer

350
00:15:40,470 --> 00:15:37,540
of capability but 14 and a half years

351
00:15:42,389 --> 00:15:40,480
later and 45 kilometres of Optometry

352
00:15:44,510 --> 00:15:42,399
we've done phenomenal things we've

353
00:15:48,660 --> 00:15:44,520
greatly expanded our understanding of

354
00:15:51,329 --> 00:15:48,670
the red planet so you know why did these

355
00:15:53,579 --> 00:15:51,339
Rovers last so long why didn't he last

356
00:15:57,900 --> 00:15:53,589
so long well well there are two main

357
00:16:00,060 --> 00:15:57,910
technical reasons one is that we had

358
00:16:01,560 --> 00:16:00,070
expected that dust falling out of the

359
00:16:03,720 --> 00:16:01,570
air would accumulate on the solar rays

360
00:16:06,240 --> 00:16:03,730
that eventually choke off power after

361
00:16:07,590 --> 00:16:06,250
about 90 days but well we didn't expect

362
00:16:09,960 --> 00:16:07,600
is that wind would come along

363
00:16:12,210 --> 00:16:09,970

periodically and blow the dust off the

364
00:16:14,579 --> 00:16:12,220
arrays and this on a seasonal cycle

365
00:16:16,800 --> 00:16:14,589
actually became pretty reliable and

366
00:16:18,540 --> 00:16:16,810
allowed us to survive not just the first

367
00:16:20,340 --> 00:16:18,550
winter but all the winters we

368
00:16:22,650 --> 00:16:20,350
experienced on Mars and to keep going

369
00:16:24,660 --> 00:16:22,660
and exploring the other thing was that

370
00:16:26,850 --> 00:16:24,670
these Rovers actually have the finest

371
00:16:29,360 --> 00:16:26,860
batteries in the solar system you know

372
00:16:35,069 --> 00:16:29,370
they have over 5,000 charge/discharge

373
00:16:37,680 --> 00:16:35,079
cycles on them and they still have about

374
00:16:39,329 --> 00:16:37,690
85 are had about 85 percent of their

375
00:16:41,970 --> 00:16:39,339
capacity I mean we'd all love if their

376
00:16:44,490 --> 00:16:41,980
cellphone batteries lasted this long but

377
00:16:46,230 --> 00:16:44,500
that really was an enabling capability

378
00:16:47,430 --> 00:16:46,240
that with the dust cleaning and the

379
00:16:49,470 --> 00:16:47,440
batteries allowed us to have that

380
00:16:51,780 --> 00:16:49,480
critical energy we needed to get through

381
00:16:55,079 --> 00:16:51,790
the coldest darkest parts of the winter

382
00:16:56,340 --> 00:16:55,089
on Mars and to keep exploring and

383
00:16:57,990 --> 00:16:56,350
explore we have

384
00:16:59,970 --> 00:16:58,000
done phenomenal things and hear about

385
00:17:02,400 --> 00:16:59,980
some of that but we had many challenges

386
00:17:04,590 --> 00:17:02,410
along the way I mean when we first

387
00:17:06,450 --> 00:17:04,600
landed on Mars one of the things that

388
00:17:08,880 --> 00:17:06,460

happened is we have a heater on the

389
00:17:11,220 --> 00:17:08,890
robotic arm on the rover that got stuck

390
00:17:13,650 --> 00:17:11,230
on and so every night that heater would

391
00:17:16,860 --> 00:17:13,660
come on and waste energy from the rover

392
00:17:18,570 --> 00:17:16,870
if they we left it alone like that the

393
00:17:20,700 --> 00:17:18,580
mission wouldn't have lasted long beyond

394
00:17:23,010 --> 00:17:20,710
the the 90 days so we developed this

395
00:17:25,230 --> 00:17:23,020
technique called deep sleep which is

396
00:17:27,690 --> 00:17:25,240
every night we would turn everything off

397
00:17:30,150 --> 00:17:27,700
of the rover including all the survival

398
00:17:32,100 --> 00:17:30,160
heaters and the rover would get cold but

399
00:17:33,300 --> 00:17:32,110
it would stay just warm enough that in

400
00:17:35,010 --> 00:17:33,310
the morning when the Sun would come up

401
00:17:37,470 --> 00:17:35,020
and we would power everything back up it

402
00:17:39,360 --> 00:17:37,480
never got below its allowable

403
00:17:42,660 --> 00:17:39,370
temperatures you know this is kind of

404
00:17:45,480 --> 00:17:42,670
like you have a the light in your

405
00:17:47,040 --> 00:17:45,490
bedroom is stuck on and you can't sleep

406
00:17:48,450 --> 00:17:47,050
so what you do is you go outside and you

407
00:17:50,760 --> 00:17:48,460
turn off the master breaker for your

408
00:17:53,460 --> 00:17:50,770
house but that means your refrigerator

409
00:17:55,080 --> 00:17:53,470
starts to warm up but you know by the

410
00:17:56,460 --> 00:17:55,090
morning time when you wake up and you

411
00:17:58,860 --> 00:17:56,470
turn the breaker back on the ice cream

412
00:18:00,540 --> 00:17:58,870
hasn't melted too badly and you do that

413
00:18:02,790 --> 00:18:00,550

every single night and imagine doing

414
00:18:05,490 --> 00:18:02,800
that for five thousand nights and that's

415
00:18:08,670 --> 00:18:05,500
what we had to do for this vehicle but

416
00:18:10,320 --> 00:18:08,680
it also partially perhaps explains why

417
00:18:12,900 --> 00:18:10,330
we weren't able to recover the rover

418
00:18:15,030 --> 00:18:12,910
because with the loss of power the clock

419
00:18:17,850 --> 00:18:15,040
on the rover gets scrambled and it

420
00:18:19,950 --> 00:18:17,860
wouldn't know when to deep sleep and so

421
00:18:22,500 --> 00:18:19,960
it probably wasn't sleeping at night

422
00:18:25,140 --> 00:18:22,510
would it needed to and that heater was

423
00:18:27,690 --> 00:18:25,150
stuck on draining away whatever energy

424
00:18:31,260 --> 00:18:27,700
the solar arrays were accumulating from

425
00:18:33,300 --> 00:18:31,270
the Sun to charge those batteries so

426
00:18:35,400 --> 00:18:33,310
that might be part of this explanation

427
00:18:39,810 --> 00:18:35,410
in addition to the fact that now it's

428
00:18:41,280 --> 00:18:39,820
much colder and darker on Mars but we

429
00:18:42,930 --> 00:18:41,290
had many other challenges many of the

430
00:18:44,910 --> 00:18:42,940
people in this room know you know we

431
00:18:47,520 --> 00:18:44,920
suffered from amnesia on the rover where

432
00:18:49,290 --> 00:18:47,530
the flash memory stopped working and the

433
00:18:51,120 --> 00:18:49,300
vehicle wouldn't remember anything past

434
00:18:53,070 --> 00:18:51,130
shutting down and sleeping at night so

435
00:18:55,200 --> 00:18:53,080
we had to make sure that wood got down

436
00:18:57,270 --> 00:18:55,210
everyday all the critical science

437
00:18:59,790 --> 00:18:57,280
information we collected that day and we

438
00:19:03,420 --> 00:18:59,800

did that for many years on this vehicle

439
00:19:05,700 --> 00:19:03,430
so all those things were accomplished by

440
00:19:07,460 --> 00:19:05,710
a phenomenal engineering and science

441
00:19:09,690 --> 00:19:07,470
team we were innovative in

442
00:19:11,580 --> 00:19:09,700
problem-solving and figure out ways

443
00:19:14,519 --> 00:19:11,590
to keep this Rover going and how to keep

444
00:19:17,430 --> 00:19:14,529
it productive and to continue that

445
00:19:19,200 --> 00:19:17,440
exploration and scientific discovery the

446
00:19:21,509 --> 00:19:19,210
fact that we lasted so long also meant

447
00:19:23,549 --> 00:19:21,519
that you know we lost some people sadly

448
00:19:25,289 --> 00:19:23,559
some of our colleagues passed away but

449
00:19:27,389 --> 00:19:25,299
many people moved on to other things

450
00:19:29,580 --> 00:19:27,399
other projects and other endeavors and

451
00:19:31,889 --> 00:19:29,590
so we had to replace those people and we

452
00:19:34,139 --> 00:19:31,899
hired in many young people onto this

453
00:19:37,070 --> 00:19:34,149
project and train them to be experienced

454
00:19:39,570 --> 00:19:37,080
engineers we had literally a pipeline of

455
00:19:42,210 --> 00:19:39,580
training young engineers to be

456
00:19:43,769 --> 00:19:42,220
phenomenal contributors for their

457
00:19:46,080 --> 00:19:43,779
careers going forward and here at JPL

458
00:19:47,970 --> 00:19:46,090
and for NASA and that's been one of the

459
00:19:50,840 --> 00:19:47,980
rewarding legacies of this project is

460
00:19:53,250 --> 00:19:50,850
that we've produced a generation of

461
00:19:56,190 --> 00:19:53,260
scientists and engineers that can go on

462
00:19:57,810 --> 00:19:56,200
to do even greater things so I'll turn

463
00:19:59,669 --> 00:19:57,820

it over to our deputy project scientist

464
00:20:01,769 --> 00:19:59,679
to say a little bit about this dust

465
00:20:02,430 --> 00:20:01,779
storm and and some of the signs we did

466
00:20:04,169 --> 00:20:02,440
Abbey

467
00:20:06,620 --> 00:20:04,179
sure thank you very much John if we

468
00:20:09,120 --> 00:20:06,630
could show the graphic of the dust storm

469
00:20:11,190 --> 00:20:09,130
this was a historic just dorm and we

470
00:20:14,159 --> 00:20:11,200
needed a historic dust storm to finish

471
00:20:15,990 --> 00:20:14,169
this historic mission up on your screen

472
00:20:17,970 --> 00:20:16,000
you can see a simulation of what the Sun

473
00:20:19,649 --> 00:20:17,980
usually looks like so all the way on the

474
00:20:22,289 --> 00:20:19,659
left where there's a really bright Sun

475
00:20:24,899 --> 00:20:22,299
that's a typical summer day on Mars in

476
00:20:27,539 --> 00:20:24,909
the middle of the image that's about as

477
00:20:28,970 --> 00:20:27,549
dark as the Sun got in the previous dust

478
00:20:33,360 --> 00:20:28,980
storm both Spirit and Opportunity

479
00:20:35,610 --> 00:20:33,370
experienced in 2007 this past dust storm

480
00:20:37,259 --> 00:20:35,620
we could tell that the sky got as dark

481
00:20:39,690 --> 00:20:37,269
as what you see all the way on the right

482
00:20:41,669 --> 00:20:39,700
hand side the sky was so dark we

483
00:20:45,320 --> 00:20:41,679
couldn't see the Sun and these solar

484
00:20:48,029 --> 00:20:45,330
panels couldn't recharge the battery I

485
00:20:50,970 --> 00:20:48,039
speak a little bit to John's statement

486
00:20:53,850 --> 00:20:50,980
about the legacy of this Rover when

487
00:20:56,399 --> 00:20:53,860
opportunity landed back in 2004 I was

488
00:20:58,019 --> 00:20:56,409

actually in high school I was a high

489
00:21:01,110 --> 00:20:58,029
school junior but I had the amazing

490
00:21:03,720 --> 00:21:01,120
opportunity to come to JPL and actually

491
00:21:05,120 --> 00:21:03,730
be here when the Rovers landed I was a

492
00:21:09,950 --> 00:21:05,130
participant in an outreach program

493
00:21:12,810 --> 00:21:09,960
sponsored by the Planetary Society and I

494
00:21:15,480 --> 00:21:12,820
was actually in this room on landing

495
00:21:17,009 --> 00:21:15,490
night there I am standing right over

496
00:21:19,350 --> 00:21:17,019
there for the press conference but

497
00:21:21,440 --> 00:21:19,360
that's a picture of me with the science

498
00:21:23,360 --> 00:21:21,450
team seeing the first images come back

499
00:21:25,669 --> 00:21:23,370
and it was those first images from

500
00:21:29,210 --> 00:21:25,679
opportunity that inspired me to become a

501
00:21:30,830 --> 00:21:29,220
planetary scientist they revealed a view

502
00:21:33,259 --> 00:21:30,840
of Mars that we had never seen before

503
00:21:35,750 --> 00:21:33,269
and I was in the room with the folks who

504
00:21:39,590 --> 00:21:35,760
were so excited to see that bedrock in

505
00:21:41,690 --> 00:21:39,600
that crater and I wanted to know why you

506
00:21:43,399 --> 00:21:41,700
know I I've been hearing a lot of

507
00:21:46,159 --> 00:21:43,409
people's stories both from within the

508
00:21:48,289 --> 00:21:46,169
project from within JPL and from all

509
00:21:51,139 --> 00:21:48,299
over the world via social media and what

510
00:21:53,450 --> 00:21:51,149
strikes me as so cool is that this story

511
00:21:55,759 --> 00:21:53,460
is not unique for me there really are

512
00:21:58,399 --> 00:21:55,769
hundreds if not thousands of students

513
00:22:00,440 --> 00:21:58,409

who are just like me who witnessed these

514
00:22:01,850 --> 00:22:00,450
Rovers and followed along their mission

515
00:22:04,639 --> 00:22:01,860
from the images they released to the

516
00:22:06,799 --> 00:22:04,649
public over the last 15 years and it

517
00:22:09,139 --> 00:22:06,809
because of that went to pursue careers

518
00:22:10,549 --> 00:22:09,149
in science and education and math so

519
00:22:18,040 --> 00:22:10,559
thank you all so much and I'll turn it

520
00:22:22,900 --> 00:22:20,110
we're just going to take a beat could I

521
00:22:25,840 --> 00:22:22,910
just get a show of hands of how many of

522
00:22:30,070 --> 00:22:25,850
you here was happen to be in high school

523
00:22:32,460 --> 00:22:30,080
or below how many have you been here

524
00:22:36,520 --> 00:22:32,470
since the very beginning of the mission

525
00:22:40,180 --> 00:22:36,530
this is fabulous to see that it has gone

526
00:22:42,280 --> 00:22:40,190
through generations this is so cool when

527
00:22:49,660 --> 00:22:42,290
we come back we look at the scientific

528
00:22:51,700 --> 00:22:49,670
discoveries one of the other things

529
00:22:53,020 --> 00:22:51,710
about this project has been a truly

530
00:22:55,900 --> 00:22:53,030
unique opportunity for everybody

531
00:22:57,760 --> 00:22:55,910
involved is the people that have been

532
00:23:01,390 --> 00:22:57,770
involved in the entire process yes the

533
00:23:03,160 --> 00:23:01,400
project is about a robot but the reality

534
00:23:03,640 --> 00:23:03,170
is that robot was built by a bunch of

535
00:23:06,130 --> 00:23:03,650
people

536
00:23:08,740 --> 00:23:06,140
the reason this thing has lasted so long

537
00:23:11,440 --> 00:23:08,750
goes back first and foremost to the

538
00:23:12,970 --> 00:23:11,450

people who don't know there was a team

539
00:23:15,310 --> 00:23:12,980
of engineers at the Jet Propulsion

540
00:23:16,780 --> 00:23:15,320
Laboratory at some other institutions as

541
00:23:19,810 --> 00:23:16,790
well but primarily JPL

542
00:23:22,750 --> 00:23:19,820
that 19 years ago were given a task that

543
00:23:24,670 --> 00:23:22,760
many people thought was impossible that

544
00:23:27,550 --> 00:23:24,680
group of engineers built these

545
00:23:30,280 --> 00:23:27,560
extraordinary rip machines the reason

546
00:23:33,250 --> 00:23:30,290
that missions with spirit of opportunity

547
00:23:35,110 --> 00:23:33,260
instead of being 90 days and deriving

548
00:23:36,790 --> 00:23:35,120
half a kilometer on them across the

549
00:23:39,190 --> 00:23:36,800
Martian surface turned out to be this

550
00:23:41,290 --> 00:23:39,200
more than decade-long adventure of over

551
00:23:47,350 --> 00:23:41,300
land exploration is because of those

552
00:23:49,660 --> 00:23:47,360
engineers and what they did some folks

553
00:23:52,570 --> 00:23:49,670
forget that opportunity was actually a

554
00:23:56,620 --> 00:23:52,580
twin the Mars Exploration Rover mission

555
00:23:58,690 --> 00:23:56,630
also had spirit that explored on the

556
00:24:01,840 --> 00:23:58,700
other side of Mars and a place called

557
00:24:04,510 --> 00:24:01,850
Gusev crater and just like Opportunity

558
00:24:07,750 --> 00:24:04,520
Spirit went well past his fault

559
00:24:10,240 --> 00:24:07,760
warranty and brought together lots of

560
00:24:12,520 --> 00:24:10,250
science for our team and let me

561
00:24:15,310 --> 00:24:12,530
introduce you now to Steve Squyres

562
00:24:17,320 --> 00:24:15,320
he is the principal investigator and

563
00:24:19,090 --> 00:24:17,330

Matt galumbeck he's the project

564
00:24:21,850 --> 00:24:19,100
scientist to tell us about some of these

565
00:24:24,430 --> 00:24:21,860
findings thank you guy and let me just

566
00:24:25,870 --> 00:24:24,440
first say it's it's so good to see so

567
00:24:28,420 --> 00:24:25,880
many of my dear friends and colleagues

568
00:24:29,760 --> 00:24:28,430
from the mars exploration rover project

569
00:24:31,740 --> 00:24:29,770
past

570
00:24:35,700 --> 00:24:31,750
and present I love you guys and it's

571
00:24:39,360 --> 00:24:35,710
just great to see everybody Spirit and

572
00:24:44,430 --> 00:24:39,370
Opportunity were robotic field

573
00:24:47,370 --> 00:24:44,440
geologists geology is it's a forensic

574
00:24:48,690 --> 00:24:47,380
science a geologist is like a detective

575
00:24:51,150 --> 00:24:48,700
at the scene of a crime something

576
00:24:53,820 --> 00:24:51,160
happened at this place on Mars billions

577
00:24:56,190 --> 00:24:53,830
of years ago what was it what was it

578
00:24:57,870 --> 00:24:56,200
like there back then and you're looking

579
00:25:00,300 --> 00:24:57,880
for clues and the clues are in the rocks

580
00:25:02,640 --> 00:25:00,310
and so we equipped these vehicles was

581
00:25:06,540 --> 00:25:02,650
the tools that they needed to read those

582
00:25:09,300 --> 00:25:06,550
clues now spirits mission really began

583
00:25:12,030 --> 00:25:09,310
in earnest a hundred and fifty six days

584
00:25:14,610 --> 00:25:12,040
into our 90-day mission when we reached

585
00:25:17,250 --> 00:25:14,620
the Columbia Hills this wonderful range

586
00:25:19,830 --> 00:25:17,260
of hills that we named to honor the

587
00:25:25,380 --> 00:25:19,840
memories of the Columbia space shuttle

588
00:25:29,340 --> 00:25:25,390

astronauts and the clues there told us

589
00:25:32,310 --> 00:25:29,350
about what Mars was like at this place

590
00:25:37,230 --> 00:25:32,320
very long ago very early in Martian

591
00:25:39,360 --> 00:25:37,240
history Mars today is cold and dry and

592
00:25:43,970 --> 00:25:39,370
pretty desolate world it's a place where

593
00:25:48,650 --> 00:25:43,980
not much happens okay but at that place

594
00:25:51,510 --> 00:25:48,660
long ago it was it was it was a hot

595
00:25:54,150 --> 00:25:51,520
violent steamy place there was a lot

596
00:25:56,640 --> 00:25:54,160
going on there were impacts violent

597
00:25:59,990 --> 00:25:56,650
impacts that produce craters and crater

598
00:26:02,160 --> 00:26:00,000
ejecta there were volcanic explosions

599
00:26:04,560 --> 00:26:02,170
volcanic lava would come into contact

600
00:26:06,510 --> 00:26:04,570
with water and ice below the ground it

601
00:26:08,490 --> 00:26:06,520
would flash into steam and go kaboom and

602
00:26:10,770 --> 00:26:08,500
throw rocks everywhere we would see

603
00:26:13,410 --> 00:26:10,780
those deposits most compellingly

604
00:26:16,950 --> 00:26:13,420
we saw profound evidence for

605
00:26:20,250 --> 00:26:16,960
hydrothermal activity hot water there

606
00:26:22,650 --> 00:26:20,260
were steam steam vents things about that

607
00:26:24,570 --> 00:26:22,660
geologists would call volcanic fumaroles

608
00:26:26,280 --> 00:26:24,580
there was steam coming out of the ground

609
00:26:28,560 --> 00:26:26,290
there were hot springs you know it

610
00:26:31,500 --> 00:26:28,570
sounds like it sounds like a scary place

611
00:26:32,610 --> 00:26:31,510
and it actually was in a sense but it

612
00:26:36,180 --> 00:26:32,620
was the kind of place that would have

613
00:26:39,060 --> 00:26:36,190

been very very suitable for some kinds

614
00:26:43,320 --> 00:26:39,070
of very Hardy microbes it's a place that

615
00:26:47,010 --> 00:26:43,330
was habitable now opportunities

616
00:26:49,170 --> 00:26:47,020
mission opportunity had two missions the

617
00:26:52,950 --> 00:26:49,180
first one lasted for about nine years

618
00:26:55,920 --> 00:26:52,960
it started saw one first day that we

619
00:26:59,070 --> 00:26:55,930
landed it was geologic pay dirt right

620
00:27:01,620 --> 00:26:59,080
from the very beginning now the story in

621
00:27:03,930 --> 00:27:01,630
the clues in the rocks at the

622
00:27:06,140 --> 00:27:03,940
opportunity site was very different

623
00:27:08,550 --> 00:27:06,150
these were somewhat younger rocks and

624
00:27:10,160 --> 00:27:08,560
what they showed was evidence that there

625
00:27:12,210 --> 00:27:10,170
had been liquid water below the surface

626
00:27:14,240 --> 00:27:12,220
liquid water that had come to the

627
00:27:18,920 --> 00:27:14,250
surface trickled across the ground

628
00:27:20,910 --> 00:27:18,930
evaporated away but it wasn't my stuff

629
00:27:22,350 --> 00:27:20,920
you know we were running around saying

630
00:27:25,710 --> 00:27:22,360
water on Mars water on Mars it was

631
00:27:27,660 --> 00:27:25,720
really sulfuric acid on Mars okay the pH

632
00:27:30,810 --> 00:27:27,670
was very low this is very acidic stuff

633
00:27:33,870 --> 00:27:30,820
it was very salty this was not evidence

634
00:27:36,330 --> 00:27:33,880
of an evolutionary paradise but it was a

635
00:27:38,430 --> 00:27:36,340
fascinating fascinating environment and

636
00:27:40,530 --> 00:27:38,440
we studied that place by going to a

637
00:27:42,090 --> 00:27:40,540
series of impact craters first little

638
00:27:44,730 --> 00:27:42,100

Eagle crater smaller than this room

639
00:27:47,310 --> 00:27:44,740
where we landed then endurance crater

640
00:27:50,310 --> 00:27:47,320
and then ultimately the long six

641
00:27:53,220 --> 00:27:50,320
kilometer trek down to Victoria crater

642
00:27:55,380 --> 00:27:53,230
and we were a Victoria for for two years

643
00:27:59,550 --> 00:27:55,390
about a year along the rim another year

644
00:28:03,030 --> 00:27:59,560
down inside and by the time we wrapped

645
00:28:04,890 --> 00:28:03,040
up the investigation at Victoria we'd

646
00:28:06,660 --> 00:28:04,900
been at that point on Mars four and a

647
00:28:09,510 --> 00:28:06,670
half five years something like that we'd

648
00:28:12,150 --> 00:28:09,520
put a better part of seven or eight

649
00:28:14,630 --> 00:28:12,160
kilometers on the odometer we had kind

650
00:28:17,550 --> 00:28:14,640
of done most of what you could do on

651
00:28:19,920 --> 00:28:17,560
these rocks you know we had we had done

652
00:28:22,290 --> 00:28:19,930
stratigraphic sections we had been down

653
00:28:24,660 --> 00:28:22,300
into these craters we had really pieced

654
00:28:27,660 --> 00:28:24,670
together a compelling detailed

655
00:28:32,220 --> 00:28:27,670
scientifically nuanced story of what had

656
00:28:32,790 --> 00:28:32,230
happened but then we had to decide what

657
00:28:37,250 --> 00:28:32,800
to do next

658
00:28:39,720 --> 00:28:37,260
and what we could have done I suppose

659
00:28:41,580 --> 00:28:39,730
was just kind of noodle around on the

660
00:28:43,490 --> 00:28:41,590
plains until the wheels fell off but it

661
00:28:48,210 --> 00:28:43,500
didn't feel like the right thing to do

662
00:28:50,610 --> 00:28:48,220
it was not that was not a goal worthy of

663
00:28:52,530 --> 00:28:50,620

this Rover it was a not a goal worthy of

664
00:28:55,830 --> 00:28:52,540
this team so we made the decision at

665
00:29:00,450 --> 00:28:55,840
that point to do the long law

666
00:29:02,190 --> 00:29:00,460
long drive to endeavour crater it was

667
00:29:04,529 --> 00:29:02,200
what was it Matt four and a half years

668
00:29:07,890 --> 00:29:04,539
something like that to get down there 20

669
00:29:10,230 --> 00:29:07,900
kilometers it was excruciating but we

670
00:29:12,450 --> 00:29:10,240
got there and when we got there the the

671
00:29:14,159 --> 00:29:12,460
mission started all over again new rocks

672
00:29:16,680 --> 00:29:14,169
new stories looking into the very

673
00:29:19,409 --> 00:29:16,690
distant past we were able at the rim of

674
00:29:21,510 --> 00:29:19,419
Endeavour crater to find rocks that were

675
00:29:24,269 --> 00:29:21,520
probably the oldest observed by either

676
00:29:26,130 --> 00:29:24,279
one of the rover's rocks that even

677
00:29:28,860 --> 00:29:26,140
predated the formation of Endeavour

678
00:29:31,440 --> 00:29:28,870
crater and those told a story of water

679
00:29:33,570 --> 00:29:31,450
coursing through the rocks but with a

680
00:29:36,210 --> 00:29:33,580
neutral pH it was water you could drink

681
00:29:37,950 --> 00:29:36,220
and so we were able to piece together a

682
00:29:39,720 --> 00:29:37,960
new story there that was one of the

683
00:29:42,389 --> 00:29:39,730
missions most significant discoveries

684
00:29:46,789 --> 00:29:42,399
that came 11 years into our 90-day

685
00:29:49,200 --> 00:29:46,799
mission Matt so the Traverse from

686
00:29:54,139 --> 00:29:49,210
Victoria to endeavour was not

687
00:29:57,480 --> 00:29:54,149
excruciating it was incredibly exciting

688
00:29:59,399 --> 00:29:57,490

so for someone whose day job is trying

689
00:30:02,580 --> 00:29:59,409
to figure out where to land spacecraft

690
00:30:04,769 --> 00:30:02,590
on Mars the science behind that is

691
00:30:07,320 --> 00:30:04,779
looking at remote sensing data and

692
00:30:10,200 --> 00:30:07,330
predicting down what's on the ground and

693
00:30:12,450 --> 00:30:10,210
when we got to Victoria crater the world

694
00:30:14,750 --> 00:30:12,460
opened up in a way that it never had

695
00:30:18,180 --> 00:30:14,760
before with hi-rise images

696
00:30:20,700 --> 00:30:18,190
high-resolution images at 25 centimeters

697
00:30:23,820 --> 00:30:20,710
per pixel for the first time we could

698
00:30:27,149 --> 00:30:23,830
see our rover sitting on the surface and

699
00:30:29,760 --> 00:30:27,159
that means you could figure out where to

700
00:30:32,399 --> 00:30:29,770
drive it and have a knowledge that it

701
00:30:35,010 --> 00:30:32,409
would be a safe path or not now the

702
00:30:38,039 --> 00:30:35,020
distance in line of sight between

703
00:30:41,779 --> 00:30:38,049
Victoria and Endeavour was maybe 16

704
00:30:44,460 --> 00:30:41,789
kilometers but along that path were

705
00:30:47,610 --> 00:30:44,470
seventy percent of the surface included

706
00:30:50,490 --> 00:30:47,620
Abed forms large ripples that could eat

707
00:30:51,899 --> 00:30:50,500
you're over and we didn't want our Rover

708
00:30:55,350 --> 00:30:51,909
to be eaten by a bad form

709
00:30:57,870 --> 00:30:55,360
it wasn't the idea so we had to figure

710
00:31:00,870 --> 00:30:57,880
out a path and Tim Parker and I spent

711
00:31:03,450 --> 00:31:00,880
years looking at the hi-rise images and

712
00:31:06,960 --> 00:31:03,460
we came up with variety paths we had the

713
00:31:09,060 --> 00:31:06,970

blue path we had the yellow path we we

714
00:31:09,370 --> 00:31:09,070
had the gold path and finally they had

715
00:31:39,850 --> 00:31:09,380
the

716
00:31:41,740 --> 00:31:39,860
checked out and said you know remind me

717
00:31:46,450 --> 00:31:41,750
when we get to an outcrop because these

718
00:31:48,880 --> 00:31:46,460
ripples just are doing it for me but to

719
00:31:51,670 --> 00:31:48,890
me it was tremendously exciting to be

720
00:31:54,220 --> 00:31:51,680
able to know where you were and relate

721
00:31:56,320 --> 00:31:54,230
it to what you saw around you and help

722
00:32:02,470 --> 00:31:56,330
the Rover planners decide where to go

723
00:32:05,650 --> 00:32:02,480
next okay so that was the fun part so

724
00:32:08,620 --> 00:32:05,660
the question is what what science what

725
00:32:12,430 --> 00:32:08,630
clues in the rocks allowed us to come up

726
00:32:15,700 --> 00:32:12,440
with a story of a battery acid in the

727
00:32:19,420 --> 00:32:15,710
middle Martian history and cleaner water

728
00:32:23,020 --> 00:32:19,430
later and the clues were in the rocks at

729
00:32:25,960 --> 00:32:23,030
Eagle crater and earlier locations we

730
00:32:29,050 --> 00:32:25,970
saw sulfates and stones so these are

731
00:32:32,470 --> 00:32:29,060
rocks with little sand sized particles

732
00:32:35,110 --> 00:32:32,480
and their composition was largely sulfur

733
00:32:37,420 --> 00:32:35,120
or or a large part of it was sulfur and

734
00:32:40,540 --> 00:32:37,430
they were finally laminated and layered

735
00:32:43,060 --> 00:32:40,550
and we started thinking about it and the

736
00:32:47,140 --> 00:32:43,070
the way we could get these rocks by was

737
00:32:49,780 --> 00:32:47,150
evaporating salty water and the

738
00:32:55,360 --> 00:32:49,790

evaporation that left these minerals

739
00:32:57,670 --> 00:32:55,370
were then put into bed forms sand dunes

740
00:32:59,650 --> 00:32:57,680
that moved him around the water then

741
00:33:02,830 --> 00:32:59,660
course through the rocks and created the

742
00:33:06,010 --> 00:33:02,840
blueberries so that led us to the story

743
00:33:08,410 --> 00:33:06,020
of acid rich water which we don't

744
00:33:11,350 --> 00:33:08,420
usually think of as being very useful

745
00:33:14,080 --> 00:33:11,360
for life as we know it but when we got

746
00:33:16,510 --> 00:33:14,090
to the rim of Endeavour crater we saw

747
00:33:19,780 --> 00:33:16,520
clay minerals clay minerals that were a

748
00:33:22,690 --> 00:33:19,790
luminal rich that could have only formed

749
00:33:25,720 --> 00:33:22,700
by pervasive alteration

750
00:33:28,000 --> 00:33:25,730
of neutral pH waters and neutral pH

751
00:33:30,100 --> 00:33:28,010
waters that's the kind of water we could

752
00:33:32,260 --> 00:33:30,110
drink and that's the kind of water that

753
00:33:36,010 --> 00:33:32,270
we think life could have gotten started

754
00:33:39,010 --> 00:33:36,020
so so this in this endeavor of going to

755
00:33:42,340 --> 00:33:39,020
endeavor crater and to exploring with

756
00:33:44,140 --> 00:33:42,350
this Rover was after one of those almost

757
00:33:47,170 --> 00:33:44,150
theological questions

758
00:33:50,850 --> 00:33:47,180
well why form anywhere that liquid water

759
00:33:54,040 --> 00:33:50,860
is stable or are we really really lucky

760
00:33:56,530 --> 00:33:54,050
back to you gain some great stories Matt

761
00:34:00,250 --> 00:33:56,540
all right when we come back we're going

762
00:34:09,080 --> 00:34:00,260
to take a peek at our next Rover

763
00:34:09,090 --> 00:34:30,880

[Applause]

764
00:34:35,260 --> 00:34:33,450
we're getting a bounce to signal

765
00:34:37,490 --> 00:34:35,270
[Applause]

766
00:34:52,729 --> 00:34:37,500
we're singing on the LPP

767
00:35:04,380 --> 00:35:01,370
[Applause]

768
00:35:07,080 --> 00:35:04,390
that's her next Rover and with us now

769
00:35:10,920 --> 00:35:07,090
right now is Jennifer trois / she gave

770
00:35:13,830 --> 00:35:10,930
us that tour and also Lorie glaze she is

771
00:35:16,860 --> 00:35:13,840
our person who looks over all the

772
00:35:20,460 --> 00:35:16,870
planetary missions coming up so let's

773
00:35:22,320 --> 00:35:20,470
take it away with Jennifer hi I am the

774
00:35:24,690 --> 00:35:22,330
project system engineer for the Mars

775
00:35:26,790 --> 00:35:24,700
2020 Rover and I'll talk a little bit

776
00:35:29,940 --> 00:35:26,800
about that and the foundation on which

777
00:35:31,350 --> 00:35:29,950
that was built which happened on the

778
00:35:33,570 --> 00:35:31,360
mars exploration rovers Spirit and

779
00:35:35,460 --> 00:35:33,580
Opportunity and amazingly I was the

780
00:35:37,380 --> 00:35:35,470
project system engineer on Spirit and

781
00:35:39,120 --> 00:35:37,390
Opportunity also so I have a unique

782
00:35:41,490 --> 00:35:39,130
perspective to talk about how those

783
00:35:44,850 --> 00:35:41,500
Rovers are really a stepping stone for

784
00:35:46,500 --> 00:35:44,860
the large Rovers that we build today and

785
00:35:48,510 --> 00:35:46,510
I actually gathered a group of folks

786
00:35:50,370 --> 00:35:48,520
there's Rob there who and some other

787
00:35:52,710 --> 00:35:50,380
people Glen I don't know if they're here

788
00:35:54,540 --> 00:35:52,720

and we talked about what we thought the

789
00:35:56,910 --> 00:35:54,550
real legacy and the stepping stones that

790
00:35:59,430 --> 00:35:56,920
Spirit and Opportunity did for us that

791
00:36:00,990 --> 00:35:59,440
helped us build the Mars 2020 Rover as

792
00:36:02,490 --> 00:36:01,000
well as a Curiosity rover and we came up

793
00:36:05,850 --> 00:36:02,500
with a couple things that I want to talk

794
00:36:09,240 --> 00:36:05,860
about today the first one was that we

795
00:36:12,390 --> 00:36:09,250
went from being stuck to being unstuck

796
00:36:14,790 --> 00:36:12,400
on Mars and what I mean by that is we

797
00:36:16,280 --> 00:36:14,800
had Viking landers we had the Pathfinder

798
00:36:19,410 --> 00:36:16,290
Lander we even had the Sojourner Rover

799
00:36:21,750 --> 00:36:19,420
but we weren't able to get to the things

800
00:36:24,360 --> 00:36:21,760
that we saw in the distance we saw

801
00:36:27,030 --> 00:36:24,370
mountains we saw rocks we saw stuff that

802
00:36:29,820 --> 00:36:27,040
our geologist wanted to get their hands

803
00:36:31,980 --> 00:36:29,830
on and we couldn't get there and so one

804
00:36:33,420 --> 00:36:31,990
of the great paradigm shifts of the Mars

805
00:36:35,370 --> 00:36:33,430
exploration Rovers Spirit and

806
00:36:37,800 --> 00:36:35,380
Opportunity was we took everything that

807
00:36:39,600 --> 00:36:37,810
we needed we put it on wheels and we

808
00:36:41,670 --> 00:36:39,610
made a geologist that could go and

809
00:36:43,290 --> 00:36:41,680
investigate the things that the science

810
00:36:45,630 --> 00:36:43,300
team was interested in and so you can

811
00:36:47,640 --> 00:36:45,640
see that here with the model this is a

812
00:36:49,560 --> 00:36:47,650
full scale model of Spirit and

813
00:36:51,720 --> 00:36:49,570

Opportunity they were twins the stuck

814
00:36:54,300 --> 00:36:51,730
heater was just opportunity but Spirit

815
00:36:55,830 --> 00:36:54,310
and Opportunity looked a lot alike and

816
00:36:57,870 --> 00:36:55,840
the things that we took with us that

817
00:36:59,610 --> 00:36:57,880
made it so that we could explore you can

818
00:37:01,230 --> 00:36:59,620
see our communications antennas a

819
00:37:04,170 --> 00:37:01,240
high-gain antenna that would track earth

820
00:37:06,120 --> 00:37:04,180
a low gain antenna a UHF antenna that

821
00:37:07,350 --> 00:37:06,130
would talk to the orbiters you can see

822
00:37:09,330 --> 00:37:07,360
the wheels that would take us everywhere

823
00:37:11,120 --> 00:37:09,340
the cameras that would show us the

824
00:37:14,269 --> 00:37:11,130
interesting places and then this row

825
00:37:16,190 --> 00:37:14,279
Karm that woulda braids rocks and would

826
00:37:18,529 --> 00:37:16,200
tell us what the rocks were made of and

827
00:37:21,319 --> 00:37:18,539
that was what our geologist was doing on

828
00:37:24,109 --> 00:37:21,329
Mars a huge paradigm shift for us the

829
00:37:25,789 --> 00:37:24,119
next thing that was significant in terms

830
00:37:29,299 --> 00:37:25,799
of building blocks of how we do business

831
00:37:31,009 --> 00:37:29,309
here at JPL was the the need to do

832
00:37:32,390 --> 00:37:31,019
things faster we had a couple

833
00:37:34,969 --> 00:37:32,400
requirements on Spirit and Opportunity

834
00:37:37,160 --> 00:37:34,979
that forced us to do things faster

835
00:37:39,739 --> 00:37:37,170
you heard the prime mission had to be

836
00:37:42,920 --> 00:37:39,749
completed in 90s all switch is 90

837
00:37:44,809 --> 00:37:42,930
Martian days that's not a lot of time to

838
00:37:46,460 --> 00:37:44,819

do all the things that we needed to do

839
00:37:49,009 --> 00:37:46,470
we also had to build the vehicle and get

840
00:37:51,049 --> 00:37:49,019
it on the launch vehicle in three years

841
00:37:52,849 --> 00:37:51,059
which we really figured out and have

842
00:37:54,559 --> 00:37:52,859
used a lot more in three years and the

843
00:37:56,569 --> 00:37:54,569
time to get there but you know three

844
00:37:58,130 --> 00:37:56,579
years we had to get it built and I want

845
00:37:59,870 --> 00:37:58,140
to talk a little bit about the 90 saw

846
00:38:02,089 --> 00:37:59,880
mission and what that made us do in

847
00:38:05,299 --> 00:38:02,099
terms of our design thinking and what we

848
00:38:08,150 --> 00:38:05,309
put onto the rover so 90 Sol's if we

849
00:38:10,339 --> 00:38:08,160
were to try to operate the rover the way

850
00:38:11,839 --> 00:38:10,349
that we operated previous spacecraft and

851
00:38:13,400 --> 00:38:11,849
you know gave him a sequence every two

852
00:38:15,859 --> 00:38:13,410
weeks we would never have been able to

853
00:38:17,930 --> 00:38:15,869
accomplish the mission that we needed to

854
00:38:19,999 --> 00:38:17,940
do in 90 Sol's and so what we had to do

855
00:38:21,799 --> 00:38:20,009
was we had to take all the things that

856
00:38:23,809 --> 00:38:21,809
the ground operators would normally do

857
00:38:25,789 --> 00:38:23,819
and code them in the software put

858
00:38:27,559 --> 00:38:25,799
high-level behaviors and autonomy on the

859
00:38:30,200 --> 00:38:27,569
vehicle so every day we could tell it

860
00:38:31,910 --> 00:38:30,210
something like drive over there and it

861
00:38:33,469 --> 00:38:31,920
would safely do it and it would get

862
00:38:35,390 --> 00:38:33,479
there on its own and we could tell it

863
00:38:36,979 --> 00:38:35,400

just the times we need it for the

864
00:38:38,509 --> 00:38:36,989
communication windows and it knew how to

865
00:38:40,190 --> 00:38:38,519
configure it had a behavior that would

866
00:38:43,219 --> 00:38:40,200
configure all the communications windows

867
00:38:45,349 --> 00:38:43,229
those things were fundamental to being

868
00:38:49,039 --> 00:38:45,359
able to do this mission quickly and we

869
00:38:51,829 --> 00:38:49,049
use them today on curiosity we use them

870
00:38:53,959 --> 00:38:51,839
on Mars 2020 in Mars 2020 is taking the

871
00:38:56,059 --> 00:38:53,969
next steps on things like Auto

872
00:38:58,150 --> 00:38:56,069
navigation right where we're making a

873
00:39:00,079 --> 00:38:58,160
new algorithm that allows us to

874
00:39:01,940 --> 00:39:00,089
autonomously navigate an even more

875
00:39:04,069 --> 00:39:01,950
complex terrain so we can go where there

876
00:39:06,079 --> 00:39:04,079
are more rocks we have another processor

877
00:39:07,880 --> 00:39:06,089
so we can go faster we're moving all

878
00:39:09,979 --> 00:39:07,890
these things forward and so this

879
00:39:12,229 --> 00:39:09,989
autonomy really started with the Mars

880
00:39:14,989 --> 00:39:12,239
exploration Rovers and it's continuing

881
00:39:17,959 --> 00:39:14,999
on today so then I have to share one of

882
00:39:20,079 --> 00:39:17,969
my what's a favorite most memorable

883
00:39:22,729 --> 00:39:20,089
moments from the Spirit and Opportunity

884
00:39:24,180 --> 00:39:22,739
missions and I know a lot of you here

885
00:39:25,710 --> 00:39:24,190
who were there at this time probably

886
00:39:27,990 --> 00:39:25,720
have this as one of your more memorable

887
00:39:30,599 --> 00:39:28,000
moments if you remember shortly after

888
00:39:33,420 --> 00:39:30,609

spirit landed 18 days into the mission

889
00:39:34,680 --> 00:39:33,430
we lost communications with spirit I was

890
00:39:37,050 --> 00:39:34,690
a spirit mission manager I was there

891
00:39:39,990 --> 00:39:37,060
that day we did not know what had

892
00:39:42,240 --> 00:39:40,000
happened we were trying to figure it out

893
00:39:43,950 --> 00:39:42,250
but we could not get communications from

894
00:39:45,599 --> 00:39:43,960
the rover and there were a number of us

895
00:39:47,790 --> 00:39:45,609
trying to figure that out what made it

896
00:39:49,620 --> 00:39:47,800
more harrowing was that opportunity was

897
00:39:51,420 --> 00:39:49,630
careening in towards Mars and we weren't

898
00:39:53,010 --> 00:39:51,430
sure if we had a problem that was going

899
00:39:54,630 --> 00:39:53,020
to cause a problem on opportunity and

900
00:39:57,690 --> 00:39:54,640
spirit so instead of being two for two

901
00:39:59,460 --> 00:39:57,700
we're gonna be 0 for 2 and so a bunch of

902
00:40:01,290 --> 00:39:59,470
us stayed here for 3 days I see Glenn

903
00:40:03,839 --> 00:40:01,300
back there didn't go home tried to

904
00:40:06,150 --> 00:40:03,849
figure this out the good news is we

905
00:40:07,950 --> 00:40:06,160
figured it out we saved spirit we saved

906
00:40:10,079 --> 00:40:07,960
opportunity and here we are today 15

907
00:40:11,309 --> 00:40:10,089
years later but the story I want to tell

908
00:40:12,630 --> 00:40:11,319
is when I was riding down in the

909
00:40:14,339 --> 00:40:12,640
elevator with dr. elachi

910
00:40:15,960 --> 00:40:14,349
after all that happened working with

911
00:40:18,870 --> 00:40:15,970
these people and there was a group of

912
00:40:20,460 --> 00:40:18,880
folks who had been working those days to

913
00:40:22,680 --> 00:40:20,470

try to figure out what was gone going on

914
00:40:24,900 --> 00:40:22,690
on the rovers with me and i had two

915
00:40:27,540 --> 00:40:24,910
really significant feelings the first

916
00:40:29,609 --> 00:40:27,550
one was obviously relief but we had kind

917
00:40:31,800 --> 00:40:29,619
of gloves saved this rover from you know

918
00:40:33,870 --> 00:40:31,810
the grave but the second one was I

919
00:40:36,569 --> 00:40:33,880
looked around at the people around me

920
00:40:39,030 --> 00:40:36,579
and I thought wow you know what an

921
00:40:42,120 --> 00:40:39,040
opportunity for a farm girl from Ohio to

922
00:40:44,700 --> 00:40:42,130
be surrounded by such amazing people a

923
00:40:47,940 --> 00:40:44,710
privilege to be part of a team that

924
00:40:49,710 --> 00:40:47,950
people could rise to this challenge and

925
00:40:52,770 --> 00:40:49,720
solve these problems whether it was the

926
00:40:54,780 --> 00:40:52,780
spirit saw late-teen anomaly or even

927
00:40:57,510 --> 00:40:54,790
just the team today who's trying to get

928
00:41:02,359 --> 00:40:57,520
spirit back or not spirit well I don't

929
00:41:06,240 --> 00:41:04,800
there was kind of a funny competition

930
00:41:07,440 --> 00:41:06,250
between Matt Wallace the opportunity

931
00:41:08,520 --> 00:41:07,450
mission manager and me the spirit

932
00:41:10,980 --> 00:41:08,530
mission manager but we won't get into

933
00:41:13,559 --> 00:41:10,990
that anyway I want to end by thanking

934
00:41:15,359 --> 00:41:13,569
the team the team from the beginning the

935
00:41:17,339 --> 00:41:15,369
team from the middle the team from the

936
00:41:19,710 --> 00:41:17,349
end for all the work that they did it's

937
00:41:21,390 --> 00:41:19,720
a privilege to be part of that team and

938
00:41:24,150 --> 00:41:21,400

now I will hand it over to Lori glaze

939
00:41:25,829 --> 00:41:24,160
from the planetary science area of NASA

940
00:41:27,510 --> 00:41:25,839
headquarters to talk about future Mars

941
00:41:28,470 --> 00:41:27,520
missions thank you so much Jennifer

942
00:41:30,270 --> 00:41:28,480
appreciate it

943
00:41:33,180 --> 00:41:30,280
so Jennifer talked a lot about the

944
00:41:34,470 --> 00:41:33,190
engineering legacy of Spirit and

945
00:41:36,329 --> 00:41:34,480
Opportunity which is absolutely

946
00:41:37,580 --> 00:41:36,339
incredible and enabling a lot of future

947
00:41:39,680 --> 00:41:37,590
exploration but I wanted to

948
00:41:43,160 --> 00:41:39,690
a little bit more about the scientific

949
00:41:46,370 --> 00:41:43,170
legacy of this incredible mission of the

950
00:41:49,340 --> 00:41:46,380
Mars Exploration Rover mission these two

951
00:41:52,040 --> 00:41:49,350
Rovers really did change the way we

952
00:41:54,230 --> 00:41:52,050
think about doing planetary science on

953
00:41:56,780 --> 00:41:54,240
the surface of other planets I loved

954
00:42:00,320 --> 00:41:56,790
listening and watching Steve Squyres

955
00:42:02,960 --> 00:42:00,330
gets so excited about the ability to

956
00:42:05,360 --> 00:42:02,970
actually roll right up to the rocks that

957
00:42:06,680 --> 00:42:05,370
we want to see roll up to them be able

958
00:42:08,990 --> 00:42:06,690
to look at them up close with a

959
00:42:10,340 --> 00:42:09,000
microscopic imager bang on them a little

960
00:42:12,170 --> 00:42:10,350
bit shake them up

961
00:42:13,550 --> 00:42:12,180
you know scratch them a little bit take

962
00:42:15,320 --> 00:42:13,560
the measurements understand what the

963
00:42:16,340 --> 00:42:15,330

chemistry is of those rocks and then say

964
00:42:18,260 --> 00:42:16,350
well that was interesting

965
00:42:20,840 --> 00:42:18,270
now I want to go over there and have

966
00:42:23,810 --> 00:42:20,850
that ability to do that so now when we

967
00:42:25,370 --> 00:42:23,820
think about doing planetary science we

968
00:42:27,140 --> 00:42:25,380
just automatically we have this new

969
00:42:29,240 --> 00:42:27,150
paradigm where we assume well we want

970
00:42:30,830 --> 00:42:29,250
mobility we need the ability to go from

971
00:42:32,510 --> 00:42:30,840
here to there we don't want to just go

972
00:42:34,400 --> 00:42:32,520
to one place and sit there and do you

973
00:42:38,840 --> 00:42:34,410
know just study that one spot we want to

974
00:42:41,570 --> 00:42:38,850
move and so it was that these two Rovers

975
00:42:44,450 --> 00:42:41,580
really set that new paradigm for how we

976
00:42:47,060 --> 00:42:44,460
want to explore and in addition to just

977
00:42:49,970 --> 00:42:47,070
that ability to move around the

978
00:42:53,030 --> 00:42:49,980
discoveries of these two Rovers the

979
00:42:55,160 --> 00:42:53,040
discovery of liquid water on the surface

980
00:42:58,760 --> 00:42:55,170
of Mars at a time in the ancient past

981
00:43:00,110 --> 00:42:58,770
has inspired the curiosity mission

982
00:43:02,690 --> 00:43:00,120
that's going on right now still

983
00:43:04,550 --> 00:43:02,700
exploring Gale Crater when curiosity

984
00:43:06,710 --> 00:43:04,560
landed in the crater where we know there

985
00:43:10,370 --> 00:43:06,720
was standing water in the ancient past

986
00:43:12,710 --> 00:43:10,380
clearly a habitable environment that has

987
00:43:14,840 --> 00:43:12,720
then inspired our next exploration which

988
00:43:17,060 --> 00:43:14,850

will be March 2020 we've now chosen the

989
00:43:18,590 --> 00:43:17,070
landing site for that mission we'll be

990
00:43:20,690 --> 00:43:18,600
landing in jezero crater where we

991
00:43:24,020 --> 00:43:20,700
believe there is an ancient River Delta

992
00:43:25,760 --> 00:43:24,030
that if life ever did come to be on Mars

993
00:43:28,250 --> 00:43:25,770
there ought to be evidence of it there

994
00:43:29,600 --> 00:43:28,260
at this location and we're so excited

995
00:43:31,130 --> 00:43:29,610
about it we're going to drive around

996
00:43:33,440 --> 00:43:31,140
with the 2020 Rover we're going to

997
00:43:35,240 --> 00:43:33,450
collect samples and we're already

998
00:43:36,890 --> 00:43:35,250
starting to work on what that next

999
00:43:39,290 --> 00:43:36,900
mission is going to be which will be a

1000
00:43:41,000 --> 00:43:39,300
Mars sample return mission we're working

1001
00:43:43,250 --> 00:43:41,010
with the Europeans on that developing

1002
00:43:44,630 --> 00:43:43,260
various concepts that would probably fly

1003
00:43:47,510 --> 00:43:44,640
at the end of the 2020s

1004
00:43:48,890 --> 00:43:47,520
to go back to jezero crater collect

1005
00:43:50,670 --> 00:43:48,900
those samples bring them back to earth

1006
00:43:52,740 --> 00:43:50,680
where we can study them and under

1007
00:43:55,350 --> 00:43:52,750
and really get a good sense of what's

1008
00:43:57,600 --> 00:43:55,360
there on the surface of Mars and all of

1009
00:43:59,940 --> 00:43:57,610
this is leading towards the ability to

1010
00:44:02,310 --> 00:43:59,950
in the future eventually put humans on

1011
00:44:03,660 --> 00:44:02,320
Mars to get the boots on the ground but

1012
00:44:06,120 --> 00:44:03,670
I just want to remind everyone in this

1013
00:44:08,220 --> 00:44:06,130

room that when we do put humans on Mars

1014
00:44:10,440 --> 00:44:08,230
they won't be going alone they're going

1015
00:44:12,840 --> 00:44:10,450
to be going along with robotic explorers

1016
00:44:15,000 --> 00:44:12,850
they'll be working together and it'll be

1017
00:44:17,220 --> 00:44:15,010
the people in this room or the people

1018
00:44:18,930 --> 00:44:17,230
that you've inspired will be helping to

1019
00:44:21,360 --> 00:44:18,940
bring both the humans and bring those

1020
00:44:22,380 --> 00:44:21,370
robotic explorers in the future I just

1021
00:44:24,120 --> 00:44:22,390
wanted to thank you all for that

1022
00:44:32,640 --> 00:44:24,130
and hand it back to gay thank you right

1023
00:44:34,140 --> 00:44:32,650
thanks Laurie okay when we come back we

1024
00:44:37,760 --> 00:44:34,150
will get some final thoughts from the

1025
00:44:41,070 --> 00:44:37,770
administrator and taking your questions

1026
00:44:42,990 --> 00:44:41,080
hello my name is Jennifer trasfer and I

1027
00:44:45,930 --> 00:44:43,000
am the project system engineer on the

1028
00:44:48,000 --> 00:44:45,940
Mars 2020 project I'm standing in the

1029
00:44:49,860 --> 00:44:48,010
spacecraft assembly facility at the Jet

1030
00:44:52,290 --> 00:44:49,870
Propulsion Laboratory where we're

1031
00:44:54,930 --> 00:44:52,300
building up the pieces of the Mars 2020

1032
00:44:56,280 --> 00:44:54,940
flight vehicle I want to show you some

1033
00:44:58,200 --> 00:44:56,290
of the flight hardware we have in here

1034
00:45:01,350 --> 00:44:58,210
that's being built right now to the far

1035
00:45:03,630 --> 00:45:01,360
left you can see the cruise stage the

1036
00:45:05,170 --> 00:45:03,640
cruise stage is the part that gets us to

1037
00:45:08,019 --> 00:45:05,180
Mars

1038
00:45:11,440 --> 00:45:08,029

and then next to the crews stage you see

1039
00:45:13,210 --> 00:45:11,450
our descent stage the descent stage does

1040
00:45:16,480 --> 00:45:13,220
our powered descent when we're landing

1041
00:45:18,849 --> 00:45:16,490
on Mars it is inside of something we

1042
00:45:22,839 --> 00:45:18,859
called Aris shell which you can see over

1043
00:45:24,849 --> 00:45:22,849
here the Aero shell has a parachute at

1044
00:45:27,849 --> 00:45:24,859
the top and the parachute will deploy

1045
00:45:29,440 --> 00:45:27,859
and slow us down at Mars and then to the

1046
00:45:31,839 --> 00:45:29,450
far right what you see is the heat

1047
00:45:33,760 --> 00:45:31,849
shield the heat shield is the part of

1048
00:45:36,039 --> 00:45:33,770
the spacecraft that faces the atmosphere

1049
00:45:38,440 --> 00:45:36,049
it ablates a little and slows us down

1050
00:45:40,420 --> 00:45:38,450
and then we jettison it and then the

1051
00:45:43,059 --> 00:45:40,430
rover comes down on the bridle and we

1052
00:45:45,970 --> 00:45:43,069
land on the surface of Mars what you see

1053
00:45:48,190 --> 00:45:45,980
over here may not look like what it is

1054
00:45:50,710 --> 00:45:48,200
but this is the beginnings of the rover

1055
00:45:53,140 --> 00:45:50,720
that's going to drive on Mars it has the

1056
00:45:54,760 --> 00:45:53,150
electronics on the inside but we don't

1057
00:45:56,769 --> 00:45:54,770
have the wheels on we don't have the

1058
00:45:59,200 --> 00:45:56,779
mobility system on we don't have the

1059
00:46:01,029 --> 00:45:59,210
belly pan on all those things are coming

1060
00:46:03,849 --> 00:46:01,039
in and over the next several months

1061
00:46:06,220 --> 00:46:03,859
we're going to finish the rover so the

1062
00:46:08,019 --> 00:46:06,230
next thing we're going to do is take all

1063
00:46:10,299 --> 00:46:08,029

of the pieces that you see here in the

1064
00:46:12,190 --> 00:46:10,309
cleanroom put them together in the

1065
00:46:13,089 --> 00:46:12,200
launch configuration and then we're

1066
00:46:15,309 --> 00:46:13,099
going to take them through our

1067
00:46:16,779 --> 00:46:15,319
environmental tests so they'll see all

1068
00:46:19,210 --> 00:46:16,789
the environments that the spacecraft

1069
00:46:21,970 --> 00:46:19,220
will see from launch all the way to

1070
00:46:28,690 --> 00:46:21,980
landing on Mars and we are on track for

1071
00:46:31,809 --> 00:46:28,700
a July 2020 lunch all right that's our

1072
00:46:34,089 --> 00:46:31,819
next Rover and with us now is the

1073
00:46:38,609 --> 00:46:34,099
administrator to talk to us about what's

1074
00:46:40,510 --> 00:46:38,619
on the future for NASA thank you yeah I

1075
00:46:42,160 --> 00:46:40,520
appreciate that very much

1076
00:46:44,500 --> 00:46:42,170
Jennifer as long as we're gonna bring

1077
00:46:46,720 --> 00:46:44,510
back spirit let's bring back Sojourner

1078
00:46:50,880 --> 00:46:46,730
as well and the two Vikings then we

1079
00:46:57,970 --> 00:46:54,730
we tried oh I'm yeah look I get it I

1080
00:47:01,630 --> 00:46:57,980
bring that up for a reason because I

1081
00:47:04,240 --> 00:47:01,640
want to emphasize the legacy of this

1082
00:47:06,339 --> 00:47:04,250
part of the NASA family what has been

1083
00:47:09,220 --> 00:47:06,349
done here at JPL is absolutely

1084
00:47:12,220 --> 00:47:09,230
astonishing and it goes back decades and

1085
00:47:14,529 --> 00:47:12,230
it's so impressive that because of what

1086
00:47:16,900 --> 00:47:14,539
you have done here we're gonna be able

1087
00:47:18,250 --> 00:47:16,910
to do a lot more on the surface of Mars

1088
00:47:20,740 --> 00:47:18,260

in the future

1089
00:47:23,049 --> 00:47:20,750
in fact when when I was learning more

1090
00:47:25,980 --> 00:47:23,059
and more about Spirit and Opportunity I

1091
00:47:28,390 --> 00:47:25,990
got to understand that these two

1092
00:47:30,670 --> 00:47:28,400
spacecraft on the way to Mars actually

1093
00:47:31,569 --> 00:47:30,680
flew through one of the worst solar

1094
00:47:33,819 --> 00:47:31,579
storms

1095
00:47:36,160 --> 00:47:33,829
one of the worst solar flares that's

1096
00:47:38,140 --> 00:47:36,170
ever been recorded and so they had to

1097
00:47:40,870 --> 00:47:38,150
actually shut down their computers and

1098
00:47:43,089 --> 00:47:40,880
then reboot them which was never

1099
00:47:45,640 --> 00:47:43,099
intended in their design while they were

1100
00:47:49,870 --> 00:47:45,650
in flight on the way to Mars and yet

1101
00:47:52,210 --> 00:47:49,880
somehow this agency in fact JPL was able

1102
00:47:55,059 --> 00:47:52,220
to able to figure out how to how to get

1103
00:47:57,190 --> 00:47:55,069
through that very scary part of the

1104
00:47:58,930 --> 00:47:57,200
mission with a whole lot of investment

1105
00:48:01,480 --> 00:47:58,940
and a whole lot of hopes on the line

1106
00:48:03,970 --> 00:48:01,490
that's an amazing achievement I remember

1107
00:48:05,589 --> 00:48:03,980
this part of the NASA family and you

1108
00:48:07,809 --> 00:48:05,599
guys hear me talk about the NASA family

1109
00:48:09,940 --> 00:48:07,819
a lot I remember when I was here for the

1110
00:48:12,579 --> 00:48:09,950
insight landing just a few short months

1111
00:48:14,200 --> 00:48:12,589
ago and we had a downlink from the

1112
00:48:16,660 --> 00:48:14,210
International Space Station so that our

1113
00:48:18,940 --> 00:48:16,670

astronauts could actually congratulate

1114
00:48:21,039 --> 00:48:18,950
the folks in this room many folks in

1115
00:48:23,500 --> 00:48:21,049
this room and others that aren't here on

1116
00:48:26,250 --> 00:48:23,510
what an amazing accomplishment it was to

1117
00:48:29,109 --> 00:48:26,260
land for the eighth time softly on the

1118
00:48:31,750 --> 00:48:29,119
surface of Mars with a successful

1119
00:48:33,819 --> 00:48:31,760
mission that's what the NASA family is

1120
00:48:36,700 --> 00:48:33,829
all about bringing together all of the

1121
00:48:39,430 --> 00:48:36,710
pieces of this agency to accomplish very

1122
00:48:41,019 --> 00:48:39,440
special things and of course one of the

1123
00:48:43,089 --> 00:48:41,029
special things that we have to figure

1124
00:48:45,130 --> 00:48:43,099
out if we're gonna fly humans to Mars is

1125
00:48:47,890 --> 00:48:45,140
how to deal with those solar flares

1126
00:48:51,220 --> 00:48:47,900
because that kind of an event with a

1127
00:48:53,529 --> 00:48:51,230
human flight to Mars could be absolutely

1128
00:48:55,480 --> 00:48:53,539
devastating so that's one of the reasons

1129
00:48:58,180 --> 00:48:55,490
we're doing the Parker Solar Probe right

1130
00:49:01,089 --> 00:48:58,190
now with our Helio physics department to

1131
00:49:02,289 --> 00:49:01,099
figure out kind of when are these solar

1132
00:49:04,329 --> 00:49:02,299
flares going to occur

1133
00:49:06,819 --> 00:49:04,339
what are the impacts going to be in fact

1134
00:49:09,849 --> 00:49:06,829
maybe even be able to predict accurately

1135
00:49:13,179 --> 00:49:09,859
enough to know when and how to send

1136
00:49:15,339 --> 00:49:13,189
humans to Mars and do it safely friends

1137
00:49:17,559 --> 00:49:15,349
there is a day coming when we're gonna

1138
00:49:19,929 --> 00:49:17,569

need the entire NASA family to come

1139
00:49:21,969 --> 00:49:19,939
together and say we're gonna put humans

1140
00:49:25,239 --> 00:49:21,979
on Mars and humans are going to be

1141
00:49:29,259 --> 00:49:25,249
working side by side with Landers and

1142
00:49:32,289 --> 00:49:29,269
Rovers and robots and it's gonna be a

1143
00:49:34,989 --> 00:49:32,299
whole of NASA in fact it could even be

1144
00:49:36,819 --> 00:49:34,999
it will be as a matter of fact a whole

1145
00:49:38,499 --> 00:49:36,829
of the world approach because we're

1146
00:49:40,929 --> 00:49:38,509
gonna need international partners and

1147
00:49:43,329 --> 00:49:40,939
that brings me to space policy directive

1148
00:49:45,729 --> 00:49:43,339
one that the president signed just a I

1149
00:49:46,900 --> 00:49:45,739
guess a little over a year ago now what

1150
00:49:48,370 --> 00:49:46,910
he said is we're gonna go to the moon

1151
00:49:50,499 --> 00:49:48,380
and we're gonna go sustainably and the

1152
00:49:52,419 --> 00:49:50,509
question is why because when we go to

1153
00:49:54,640 --> 00:49:52,429
the moon we're gonna live and work there

1154
00:49:57,039 --> 00:49:54,650
for a period of time we're gonna retire

1155
00:49:59,319 --> 00:49:57,049
risk we're going to learn how humans can

1156
00:50:00,969 --> 00:49:59,329
live on a world that's not our own and

1157
00:50:03,640 --> 00:50:00,979
we're gonna take all of those things

1158
00:50:05,799 --> 00:50:03,650
that we learn as an agency and we're

1159
00:50:08,469 --> 00:50:05,809
gonna apply them to Mars we're gonna

1160
00:50:10,779 --> 00:50:08,479
replicate as much as possible what we

1161
00:50:13,299 --> 00:50:10,789
learn at Mars and friends it's only

1162
00:50:16,269 --> 00:50:13,309
going to be possible because this entire

1163
00:50:18,489 --> 00:50:16,279

agency this important part of the agency

1164
00:50:21,069 --> 00:50:18,499
this part of the NASA family the Jet

1165
00:50:23,859 --> 00:50:21,079
Propulsion Laboratory was blazing this

1166
00:50:26,169 --> 00:50:23,869
trail is currently blazing this trail

1167
00:50:28,929 --> 00:50:26,179
not just with Spirit and Opportunity and

1168
00:50:32,679 --> 00:50:28,939
Sojourner and Viking 1 and Viking 2 but

1169
00:50:34,660 --> 00:50:32,689
now with Mars 2020 and eventually a Mars

1170
00:50:37,209 --> 00:50:34,670
return mission we're going to be able to

1171
00:50:39,579 --> 00:50:37,219
look at samples and determine if there's

1172
00:50:41,229 --> 00:50:39,589
a bio signature in their friends the

1173
00:50:43,390 --> 00:50:41,239
goal is to discover life on another

1174
00:50:45,789 --> 00:50:43,400
world that's what we're trying to

1175
00:50:48,069 --> 00:50:45,799
achieve and because of so many great

1176
00:50:50,620 --> 00:50:48,079
people in this room friends we are well

1177
00:50:52,150 --> 00:50:50,630
on our way to doing that a couple of

1178
00:50:55,120 --> 00:50:52,160
things I want to make sure everybody in

1179
00:50:57,880 --> 00:50:55,130
the audience at home understands in fact

1180
00:51:00,339 --> 00:50:57,890
because of the Curiosity rover we now

1181
00:51:03,039 --> 00:51:00,349
know that there are complex organic

1182
00:51:04,959 --> 00:51:03,049
compounds on the surface of Mars that

1183
00:51:07,749 --> 00:51:04,969
does not guarantee that there is life on

1184
00:51:10,839 --> 00:51:07,759
Mars but it increases the probability we

1185
00:51:12,549 --> 00:51:10,849
now know that the methane cycles on Mars

1186
00:51:14,949 --> 00:51:12,559
are commensurate with the seasons of

1187
00:51:15,810 --> 00:51:14,959
Mars that doesn't guarantee there's life

1188
00:51:17,940 --> 00:51:15,820

on Mars

1189
00:51:20,310 --> 00:51:17,950
increases the probability we know that

1190
00:51:22,950 --> 00:51:20,320
there's water 12 kilometers at liquid

1191
00:51:26,130 --> 00:51:22,960
water 12 kilometers under the surface of

1192
00:51:28,320 --> 00:51:26,140
Mars all of these things collude to say

1193
00:51:29,730 --> 00:51:28,330
there is a lot we need to learn and

1194
00:51:32,640 --> 00:51:29,740
friends we're going to do it quickly and

1195
00:51:34,620 --> 00:51:32,650
your legacy here at JPL and part of this

1196
00:51:37,110 --> 00:51:34,630
NASA family is critical to achieving

1197
00:51:39,120 --> 00:51:37,120
those objectives so once again thank you

1198
00:51:42,030 --> 00:51:39,130
for having me congratulations on an

1199
00:51:43,230 --> 00:51:42,040
amazing opportunity mission and Gaye

1200
00:51:48,320 --> 00:51:43,240
back to you all right

1201
00:51:48,330 --> 00:51:52,480
[Music]

1202
00:51:58,810 --> 00:51:56,200
so I must apologize we do have a hard

1203
00:52:01,630 --> 00:51:58,820
out on this program we will need to be

1204
00:52:04,360 --> 00:52:01,640
off the air at about 11:59 Pacific time

1205
00:52:06,640 --> 00:52:04,370
so I'm going to go ahead and ask for all

1206
00:52:08,890 --> 00:52:06,650
the panelists and speakers to come on up

1207
00:52:11,830 --> 00:52:08,900
and we're going to take some questions

1208
00:52:14,320 --> 00:52:11,840
now if you are on the telephone go ahead

1209
00:52:16,390 --> 00:52:14,330
and hit star one that'll put you in the

1210
00:52:19,000 --> 00:52:16,400
queue for questions and also if you have

1211
00:52:22,090 --> 00:52:19,010
social media questions you can have

1212
00:52:24,190 --> 00:52:22,100
hashtag ask NASA as a way of getting

1213
00:52:26,020 --> 00:52:24,200

your questions in again we only have a

1214
00:52:27,880 --> 00:52:26,030
few minutes I want to promise you that

1215
00:52:30,070 --> 00:52:27,890
we will still take your questions even

1216
00:52:32,170 --> 00:52:30,080
though we are off the air we have

1217
00:52:35,500 --> 00:52:32,180
speaker's standing by to take your

1218
00:52:37,930 --> 00:52:35,510
questions either by phone or online so

1219
00:52:39,790 --> 00:52:37,940
we will answer your questions let's see

1220
00:52:44,680 --> 00:52:39,800
if there's any questions here in the

1221
00:52:46,600 --> 00:52:44,690
room if not we will go to the telephone

1222
00:52:49,090 --> 00:52:46,610
do we have any quest oh we do have a

1223
00:52:52,360 --> 00:52:49,100
question here in the room right here in

1224
00:52:55,180 --> 00:52:52,370
the front third row ajs Rael from the

1225
00:53:00,730 --> 00:52:55,190
Planetary Society a question for

1226
00:53:02,140 --> 00:53:00,740
Jennifer and Steve and John what since

1227
00:53:04,720 --> 00:53:02,150
you all were there at the very beginning

1228
00:53:07,180 --> 00:53:04,730
what are you taking with you Jennifer to

1229
00:53:09,490 --> 00:53:07,190
2020 Steve what will you be taking from

1230
00:53:12,910 --> 00:53:09,500
this mission onward in John same

1231
00:53:16,000 --> 00:53:12,920
question I'll start with two things

1232
00:53:18,490 --> 00:53:16,010
first people all of these people are

1233
00:53:20,170 --> 00:53:18,500
well trained to become engineers on

1234
00:53:22,390 --> 00:53:20,180
20/20 and I'd love to have every single

1235
00:53:25,630 --> 00:53:22,400
one of them helping us build the next

1236
00:53:27,730 --> 00:53:25,640
Rover and then you know for me it's the

1237
00:53:29,320 --> 00:53:27,740
family it's the family of the people who

1238
00:53:31,240 --> 00:53:29,330

helped to develop this and we work

1239
00:53:32,950 --> 00:53:31,250
together towards the next missions and

1240
00:53:34,960 --> 00:53:32,960
it's not just this team but the team who

1241
00:53:36,610 --> 00:53:34,970
worked through all of it the teams are

1242
00:53:39,490 --> 00:53:36,620
the part behind the rover that make

1243
00:53:42,010 --> 00:53:39,500
these Rovers great well for me when I

1244
00:53:43,600 --> 00:53:42,020
started out a long time ago on the Mars

1245
00:53:46,420 --> 00:53:43,610
Exploration Rover project I was a rookie

1246
00:53:48,030 --> 00:53:46,430
pi and I made a number of silly mistakes

1247
00:53:51,220 --> 00:53:48,040
Pete I'm sure you remember a few of them

1248
00:53:53,950 --> 00:53:51,230
I learned from those learned a lot and

1249
00:53:56,110 --> 00:53:53,960
have been ill tried very hard to pass

1250
00:53:58,180 --> 00:53:56,120
some of the lessons along to two younger

1251
00:53:59,500 --> 00:53:58,190
scientists younger engineers and then I

1252
00:54:01,480 --> 00:53:59,510
would I would completely agree with

1253
00:54:03,190 --> 00:54:01,490
Jennifer it's it's really all about the

1254
00:54:04,840 --> 00:54:03,200
people in this extraordinary group of

1255
00:54:06,020 --> 00:54:04,850
people that's in this room the ones that

1256
00:54:09,380 --> 00:54:06,030
we've lost

1257
00:54:12,520 --> 00:54:09,390
along the years just it's that's the

1258
00:54:18,290 --> 00:54:12,530
real story as the people on this project

1259
00:54:19,790 --> 00:54:18,300
and for me it's the the privilege and

1260
00:54:21,920 --> 00:54:19,800
the honor to have been part of this

1261
00:54:24,079 --> 00:54:21,930
project and the honor to have been

1262
00:54:30,620 --> 00:54:24,089
serving as project manager for the last

1263
00:54:36,770 --> 00:54:30,630

12 years that I'll take with me from

1264
00:54:38,990 --> 00:54:36,780
Pathfinder most of my so this project

1265
00:54:42,380 --> 00:54:39,000
has been I've been on this project 18

1266
00:54:44,450 --> 00:54:42,390
years and from the development cycle

1267
00:54:46,400 --> 00:54:44,460
looking at the landing sites

1268
00:54:51,700 --> 00:54:46,410
all the way through operations that's

1269
00:54:56,480 --> 00:54:51,710
been half of my career it's you know

1270
00:54:58,700 --> 00:54:56,490
it's been great do we have a social

1271
00:55:01,130 --> 00:54:58,710
media question we certainly have had

1272
00:55:02,839 --> 00:55:01,140
quite an outpouring of love online lots

1273
00:55:03,230 --> 00:55:02,849
of memories with the hashtag thanks

1274
00:55:06,050 --> 00:55:03,240
Oppie

1275
00:55:08,559 --> 00:55:06,060
and quite a few people would like to

1276
00:55:11,569 --> 00:55:08,569
know if we would ever try to retrieve

1277
00:55:17,630 --> 00:55:11,579
the opportunity Rover and perhaps put it

1278
00:55:20,030 --> 00:55:17,640
in a Martian Museum yeah I've been to

1279
00:55:23,180 --> 00:55:20,040
Antarctica a number of times and I've

1280
00:55:25,730 --> 00:55:23,190
been to some of the huts that were built

1281
00:55:27,559 --> 00:55:25,740
by the early expeditions that went there

1282
00:55:32,000 --> 00:55:27,569
more than a century ago and they're left

1283
00:55:33,829 --> 00:55:32,010
exactly as they were when the

1284
00:55:35,660 --> 00:55:33,839
expeditions ended you can go in there

1285
00:55:37,430 --> 00:55:35,670
and you walk into the hut and the the

1286
00:55:39,500 --> 00:55:37,440
plates with the seal blubber are still

1287
00:55:43,670 --> 00:55:39,510
there it's exactly the way that we left

1288
00:55:45,800 --> 00:55:43,680

them so I personally would like to see

1289
00:55:47,599 --> 00:55:45,810
these we build them from Mars that's the

1290
00:55:50,120 --> 00:55:47,609
place that they were designed to go

1291
00:55:52,430 --> 00:55:50,130
that's their home that's where I would

1292
00:55:54,319 --> 00:55:52,440
like them to stay also if you had the

1293
00:55:56,150 --> 00:55:54,329
opportunity to bring a hundred and

1294
00:55:58,309 --> 00:55:56,160
eighty kilograms of stuff back from the

1295
00:55:59,690 --> 00:55:58,319
surface of Mars the last thing I want to

1296
00:56:00,550 --> 00:55:59,700
bring is something where I know exactly

1297
00:56:09,440 --> 00:56:00,560
what it's made of

1298
00:56:15,120 --> 00:56:11,850
all right let's see if we have another

1299
00:56:16,500 --> 00:56:15,130
social media question so Nathaniel Avery

1300
00:56:18,180 --> 00:56:16,510
on Twitter would like to know what are

1301
00:56:19,890 --> 00:56:18,190
some of the new questions we can ask

1302
00:56:25,590 --> 00:56:19,900
based on what's been learned by this

1303
00:56:28,859 --> 00:56:25,600
mission so I'm happy to take that great

1304
00:56:30,930 --> 00:56:28,869
question Nathaniel yeah so I speared an

1305
00:56:33,660 --> 00:56:30,940
opportunity have so advanced our ability

1306
00:56:35,640 --> 00:56:33,670
to ask questions about Mars back in 2004

1307
00:56:38,310 --> 00:56:35,650
we didn't even know if there had been

1308
00:56:40,350 --> 00:56:38,320
liquid water on the surface these Rovers

1309
00:56:42,390 --> 00:56:40,360
answered that question they revealed

1310
00:56:44,400 --> 00:56:42,400
some of the details about the timing and

1311
00:56:45,900 --> 00:56:44,410
the chemistry of that water and we're

1312
00:56:48,540 --> 00:56:45,910
asking more sophisticated questions

1313
00:56:50,370 --> 00:56:48,550

curiosity was sent to answer the

1314
00:56:52,440 --> 00:56:50,380
question okay there was water was it

1315
00:56:54,660 --> 00:56:52,450
habitable we've now found as the

1316
00:56:56,850 --> 00:56:54,670
administrator mentioned yes it was there

1317
00:56:58,770 --> 00:56:56,860
were organic molecules it was drinkable

1318
00:57:01,020 --> 00:56:58,780
water as we move forward we're now

1319
00:57:03,150 --> 00:57:01,030
asking more complex questions okay Mars

1320
00:57:04,410 --> 00:57:03,160
was habitable where's the life that's

1321
00:57:06,540 --> 00:57:04,420
part of the reason we're getting the

1322
00:57:08,460 --> 00:57:06,550
samples but we're also interested in

1323
00:57:10,560 --> 00:57:08,470
understanding why Mars as climate

1324
00:57:13,050 --> 00:57:10,570
changed what governs its habitability

1325
00:57:14,849 --> 00:57:13,060
over time and perhaps how does that

1326
00:57:17,160 --> 00:57:14,859
relate to the planets we're finding in

1327
00:57:21,750 --> 00:57:17,170
our own solar system in all across the

1328
00:57:24,000 --> 00:57:21,760
universe in other solar systems alright

1329
00:57:27,870 --> 00:57:24,010
we have a caller on the phone I believe

1330
00:57:29,700 --> 00:57:27,880
it is NASA watch go ahead keep counting

1331
00:57:32,609 --> 00:57:29,710
NASA watch comm for Steve Squyres

1332
00:57:34,800 --> 00:57:32,619
Steve as you guys drove these twin

1333
00:57:37,109 --> 00:57:34,810
rovers across Mars you'd stop at various

1334
00:57:39,150 --> 00:57:37,119
places and give them names that evoked

1335
00:57:41,550 --> 00:57:39,160
exploration mostly polar explorations

1336
00:57:43,380 --> 00:57:41,560
ships and places and people and and one

1337
00:57:46,980 --> 00:57:43,390
place was named after our mutual friend

1338
00:57:49,170 --> 00:57:46,990

Bob Gordon how would you place Spirit

1339
00:57:51,330 --> 00:57:49,180
and Opportunity in sort of the pantheon

1340
00:57:52,890 --> 00:57:51,340
of exploration vehicle such as endurance

1341
00:57:53,940 --> 00:57:52,900
and endeavour and the Beagle and the

1342
00:57:56,130 --> 00:57:53,950
Challenger

1343
00:57:57,720 --> 00:57:56,140
were they scouting parties are they weak

1344
00:58:00,030 --> 00:57:57,730
how would you what would you call them

1345
00:58:02,460 --> 00:58:00,040
in that sort of context that's a tough

1346
00:58:03,750 --> 00:58:02,470
one Keith you know I'm probably the

1347
00:58:05,310 --> 00:58:03,760
worst person in the world to ask

1348
00:58:07,560 --> 00:58:05,320
questions about the legacy of this

1349
00:58:09,510 --> 00:58:07,570
mission I'm just too close to it I do

1350
00:58:11,670 --> 00:58:09,520
have a long-standing interest in the

1351
00:58:13,349 --> 00:58:11,680
history of exploration I teach a course

1352
00:58:15,240 --> 00:58:13,359
on the history of exploration at Cornell

1353
00:58:17,820 --> 00:58:15,250
it's something that's very meaningful to

1354
00:58:19,910 --> 00:58:17,830
me and I hope that our place in that

1355
00:58:22,880 --> 00:58:19,920
pantheon as you said it turns out to be

1356
00:58:24,380 --> 00:58:22,890
important one but for me on this day at

1357
00:58:26,809 --> 00:58:24,390
the end it's just too hard for me to

1358
00:58:29,660 --> 00:58:26,819
judge alright we have another call on

1359
00:58:30,490 --> 00:58:29,670
the phone it's from the Atlantic go

1360
00:58:33,049 --> 00:58:30,500
ahead

1361
00:58:34,250 --> 00:58:33,059
hi this is marina Koren thanks for

1362
00:58:36,049 --> 00:58:34,260
taking my question

1363
00:58:38,480 --> 00:58:36,059

I'm curious what you all think is the

1364
00:58:41,299 --> 00:58:38,490
future of Rovers on Mars in general

1365
00:58:43,849 --> 00:58:41,309
after Mars 2020 do you want to spend

1366
00:58:47,510 --> 00:58:43,859
more to do similar exploration we should

1367
00:58:50,359 --> 00:58:47,520
not have spend more and why I'll take

1368
00:58:52,309 --> 00:58:50,369
that question thank you there's

1369
00:58:54,890 --> 00:58:52,319
definitely a future beyond 2020 as I

1370
00:58:56,420 --> 00:58:54,900
mentioned we were collecting samples

1371
00:58:58,460 --> 00:58:56,430
with the 2020 mission and we absolutely

1372
00:59:01,490 --> 00:58:58,470
want to get those samples back here to

1373
00:59:03,079 --> 00:59:01,500
earth and that follow-on mission we'll

1374
00:59:04,430 --> 00:59:03,089
do some additional exploration and then

1375
00:59:07,370 --> 00:59:04,440
collect the samples and bring them back

1376
00:59:10,280 --> 00:59:07,380
and I expect that the 2020 mission is

1377
00:59:12,710 --> 00:59:10,290
going to guide us towards what the next

1378
00:59:15,049 --> 00:59:12,720
mission to Mars is going to be after the

1379
00:59:18,170 --> 00:59:15,059
samples are returned and so I see a very

1380
00:59:20,569 --> 00:59:18,180
long and sustained presence at Mars and

1381
00:59:22,069 --> 00:59:20,579
the sustained exploration there as well

1382
00:59:24,230 --> 00:59:22,079
as the rest of our solar system to help

1383
00:59:26,839 --> 00:59:24,240
answer these big questions about how the

1384
00:59:28,549 --> 00:59:26,849
planets formed and how did life form on

1385
00:59:30,500 --> 00:59:28,559
earth and did it form in other places in

1386
00:59:32,420 --> 00:59:30,510
our solar system so I definitely see

1387
00:59:35,480 --> 00:59:32,430
some some future exploration in the

1388
00:59:37,190 --> 00:59:35,490

coming up alright well we promised NASA

1389
00:59:39,289 --> 00:59:37,200
that we would have a hard out on this

1390
00:59:41,599 --> 00:59:39,299
program so we're going to wrap questions

1391
00:59:44,299 --> 00:59:41,609
right now but we will take more online

1392
00:59:47,240 --> 00:59:44,309
and on the phone later on today before

1393
00:59:50,329 --> 00:59:47,250
we go we would like a round of applause

1394
00:59:54,319 --> 00:59:50,339
for all the scientists and engineers who

1395
00:59:55,300 --> 00:59:54,329
have been on this mission for 15 years