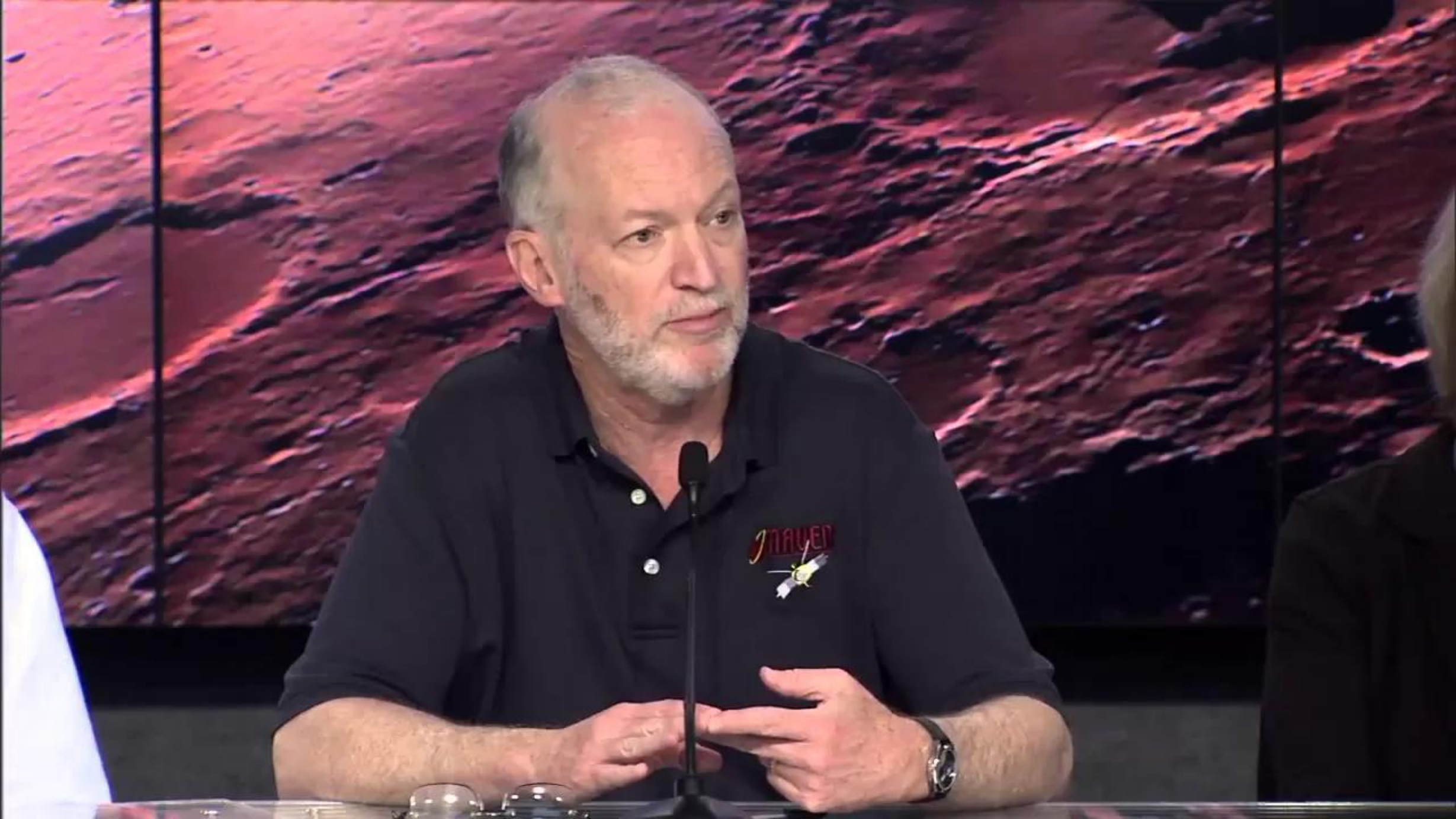
MAVEN

1
00:00:10,549 --> 00:00:08,150
hello everyone this is our mission

2
00:00:13,509 --> 00:00:10,559
science briefing for maven

3
00:00:14,910 --> 00:00:13,519
still on schedule for a launch at 1 28

4
00:00:17,830 --> 00:00:14,920
p.m on

5
00:00:20,230 --> 00:00:17,840
monday we'd like to start with a brief

6
00:00:22,470 --> 00:00:20,240
status of what is going on with maven

7
00:00:25,109 --> 00:00:22,480
and the atlas v at the launch pad

8
00:00:27,189 --> 00:00:25,119
and things are relatively quiet

9
00:00:29,509 --> 00:00:27,199
this is a crew rest day for the launch

10
00:00:32,150 --> 00:00:29,519
team everything is in readiness at the

11
00:00:34,470 --> 00:00:32,160
pad the only activity going on is

12
00:00:37,910 --> 00:00:34,480
battery charging of the maven spacecraft

13
00:00:40,310 --> 00:00:37,920

and monitoring of the state of health

14
00:00:43,110 --> 00:00:40,320
and our weather forecast for

15
00:00:45,670 --> 00:00:43,120
monday has remained the same a 40

16
00:00:47,190 --> 00:00:45,680
percent chance of no go primarily due to

17
00:00:50,069 --> 00:00:47,200
cloud constraints

18
00:00:52,389 --> 00:00:50,079
and then 60 percent no go on tuesday and

19
00:00:54,310 --> 00:00:52,399
on wednesday because the wind will

20
00:00:56,389 --> 00:00:54,320
increase some on

21
00:00:59,029 --> 00:00:56,399
tuesday and wednesday so

22
00:01:01,670 --> 00:00:59,039
monday remains our most favorable day 40

23
00:01:03,990 --> 00:01:01,680
no go or 60 go

24
00:01:07,190 --> 00:01:04,000
and at this time all is in readiness to

25
00:01:08,870 --> 00:01:07,200
pick up the countdown at 6 28 a.m on

26
00:01:11,590 --> 00:01:08,880
monday morning

27
00:01:14,230 --> 00:01:11,600
we'll start now with our presentations

28
00:01:16,870 --> 00:01:14,240
first michael meyer the lead mars

29
00:01:20,149 --> 00:01:16,880
scientist from nasa headquarters in

30
00:01:24,950 --> 00:01:22,550
bruce jakovsky the maven principal

31
00:01:27,190 --> 00:01:24,960
investigator from the laboratory for

32
00:01:31,590 --> 00:01:27,200
atmospheric and space physics at the

33
00:01:36,469 --> 00:01:34,310
janet lumen the maven deputy principal

34
00:01:40,469 --> 00:01:36,479
investigator from the university of

35
00:01:43,510 --> 00:01:40,479
california at berkeley

36
00:01:45,830 --> 00:01:43,520
nick schneider the maven iuvs instrument

37
00:01:47,830 --> 00:01:45,840
lead from the laboratory for atmospheric

38
00:01:51,990 --> 00:01:47,840

and space physics at the university of

39
00:01:56,149 --> 00:01:54,230
paul mahaffey the maven ingums

40
00:01:57,670 --> 00:01:56,159
instrument lead from nasa's goddard

41
00:02:00,149 --> 00:01:57,680
space flight center in greenbelt

42
00:02:02,789 --> 00:02:00,159
maryland

43
00:02:04,389 --> 00:02:02,799
and david mitchell the maven swia

44
00:02:06,789 --> 00:02:04,399
instrument lead from the university of

45
00:02:09,749 --> 00:02:06,799
california at berkeley

46
00:02:11,910 --> 00:02:09,759
and we'll begin first with michael meyer

47
00:02:14,070 --> 00:02:11,920
michael well thank you george

48
00:02:15,910 --> 00:02:14,080
for millennia mars has been a source of

49
00:02:16,790 --> 00:02:15,920
myth and fable

50
00:02:18,949 --> 00:02:16,800
and

51
00:02:22,309 --> 00:02:18,959
it's only a little over 50 years ago

52
00:02:23,670 --> 00:02:22,319
that we first sent a planetary probe

53
00:02:26,150 --> 00:02:23,680
into space

54
00:02:28,869 --> 00:02:26,160
to move from just myth and fable to

55
00:02:30,309 --> 00:02:28,879
actually observation and measurements

56
00:02:31,750 --> 00:02:30,319
if i could have the first

57
00:02:33,270 --> 00:02:31,760
graphic please

58
00:02:35,589 --> 00:02:33,280
our sister planet mars has been the

59
00:02:37,910 --> 00:02:35,599
focus of planetary exploration primarily

60
00:02:40,390 --> 00:02:37,920
because it's a key to understanding the

61
00:02:43,670 --> 00:02:40,400
origin and evolution of our planets

62
00:02:45,190 --> 00:02:43,680
and so we've over a little over a decade

63
00:02:47,990 --> 00:02:45,200

we've had

64
00:02:50,150 --> 00:02:48,000
spacecraft orbiters and landers that

65
00:02:52,869 --> 00:02:50,160
have worked synergistically to help

66
00:02:55,030 --> 00:02:52,879
unveil what is happening on mars and

67
00:02:56,869 --> 00:02:55,040
what may have happened in its past

68
00:02:58,869 --> 00:02:56,879
and as we see maven

69
00:03:01,350 --> 00:02:58,879
here we are getting ready to launch and

70
00:03:02,949 --> 00:03:01,360
is going to answer a key question about

71
00:03:05,589 --> 00:03:02,959
mars evolution

72
00:03:06,390 --> 00:03:05,599
and with that lead into as we can see

73
00:03:09,670 --> 00:03:06,400
other

74
00:03:13,830 --> 00:03:09,680
spacecraft that are either international

75
00:03:17,430 --> 00:03:13,840
as in provided by esa or by nasa

76
00:03:20,390 --> 00:03:17,440
going into a future of very robust mars

77
00:03:22,630 --> 00:03:20,400
exploration and trying to not only tell

78
00:03:26,470 --> 00:03:22,640
us about the evolution of climate and

79
00:03:28,949 --> 00:03:26,480
geology but also of life

80
00:03:30,869 --> 00:03:28,959
so with the next graphic i'd like to say

81
00:03:32,869 --> 00:03:30,879
you know while we've been doing all this

82
00:03:34,149 --> 00:03:32,879
what have we learned

83
00:03:36,949 --> 00:03:34,159
well one of the things that has been

84
00:03:39,910 --> 00:03:36,959
unveiled is that looking at mars and

85
00:03:41,589 --> 00:03:39,920
looking in the near subsurface we see

86
00:03:44,869 --> 00:03:41,599
that mars has actually quite an

87
00:03:47,589 --> 00:03:44,879
inventory of ice water ice in its polar

88
00:03:50,309 --> 00:03:47,599

areas and we look more at the geology

89
00:03:52,229 --> 00:03:50,319
and and mineralogy of the planet we can

90
00:03:53,990 --> 00:03:52,239
see that water once flowed on the

91
00:03:55,030 --> 00:03:54,000
surface of mars at least that's what it

92
00:03:56,869 --> 00:03:55,040
looks like

93
00:03:58,550 --> 00:03:56,879
but with rovers going to the surface and

94
00:03:59,509 --> 00:03:58,560
landers going to the surface

95
00:04:01,110 --> 00:03:59,519
we see

96
00:04:03,350 --> 00:04:01,120
mineral evidence

97
00:04:05,990 --> 00:04:03,360
of water having been at the surface of

98
00:04:07,030 --> 00:04:06,000
mars we see hematite and we see

99
00:04:09,190 --> 00:04:07,040
jimson

100
00:04:11,350 --> 00:04:09,200
discovered by two

101
00:04:13,830 --> 00:04:11,360
the mars exploration rovers

102
00:04:15,990 --> 00:04:13,840
and just recently with the rover

103
00:04:17,430 --> 00:04:16,000
curiosity we found a rock called a

104
00:04:18,949 --> 00:04:17,440
conglomerate

105
00:04:20,229 --> 00:04:18,959
this is the type of rock that we only

106
00:04:21,349 --> 00:04:20,239
find

107
00:04:23,110 --> 00:04:21,359
on earth

108
00:04:25,270 --> 00:04:23,120
in dried riverbeds

109
00:04:26,150 --> 00:04:25,280
so we now have evidence

110
00:04:27,830 --> 00:04:26,160
with

111
00:04:30,230 --> 00:04:27,840
other measurements showing that there is

112
00:04:32,629 --> 00:04:30,240
water flowing on the surface of mars we

113
00:04:34,790 --> 00:04:32,639

know that it was

114
00:04:35,749 --> 00:04:34,800
the environment at one point in time on

115
00:04:39,510 --> 00:04:35,759
mars

116
00:04:42,790 --> 00:04:39,520
was able to support microbial life

117
00:04:44,629 --> 00:04:42,800
but you look at the mars today it's cold

118
00:04:47,270 --> 00:04:44,639
it's dry

119
00:04:48,629 --> 00:04:47,280
we want to know what happened

120
00:04:50,070 --> 00:04:48,639
and with that i'll turn it over to

121
00:04:51,670 --> 00:04:50,080
george to

122
00:04:54,310 --> 00:04:51,680
the rest of the conference thank you

123
00:04:56,629 --> 00:04:54,320
michael and now to bruce jerkowski he is

124
00:04:58,710 --> 00:04:56,639
the maven principal investigator to form

125
00:05:01,029 --> 00:04:58,720
the laboratory of atmospheric and space

126
00:05:02,469 --> 00:05:01,039
physics at the university of colorado at

127
00:05:04,629 --> 00:05:02,479
boulder bruce

128
00:05:07,029 --> 00:05:04,639
thank you george michael talked about

129
00:05:08,790 --> 00:05:07,039
the geological evidence that there was

130
00:05:10,790 --> 00:05:08,800
water on ancient mars and the

131
00:05:12,710 --> 00:05:10,800
mineralogical evidence

132
00:05:15,430 --> 00:05:12,720
something clearly happened water was

133
00:05:16,870 --> 00:05:15,440
abundant on early mars the environment

134
00:05:19,670 --> 00:05:16,880
was something that was capable of

135
00:05:21,670 --> 00:05:19,680
supporting liquid water yet today we see

136
00:05:23,029 --> 00:05:21,680
a cold dry planet that is not able to

137
00:05:25,350 --> 00:05:23,039
support water

138
00:05:27,110 --> 00:05:25,360

what we want to do is to understand what

139
00:05:28,550 --> 00:05:27,120
are the reasons for that change in the

140
00:05:31,830 --> 00:05:28,560
climate

141
00:05:35,430 --> 00:05:33,909
in looking at the the drivers of the

142
00:05:37,909 --> 00:05:35,440
change in climate we're going to be able

143
00:05:39,909 --> 00:05:37,919
to understand the history of the geology

144
00:05:41,670 --> 00:05:39,919
of the planet and the history of the

145
00:05:44,070 --> 00:05:41,680
potential for life the history of the

146
00:05:46,310 --> 00:05:44,080
habitability of the planet because both

147
00:05:47,350 --> 00:05:46,320
of these depend pretty much on

148
00:05:53,909 --> 00:05:47,360
the

149
00:05:57,749 --> 00:05:53,919
with

150
00:05:59,029 --> 00:05:57,759
mars having had liquid water early on

151
00:06:00,469 --> 00:05:59,039
we think that there must have been a

152
00:06:02,309 --> 00:06:00,479
thicker atmosphere that would have

153
00:06:05,189 --> 00:06:02,319
produced greenhouse warming so that the

154
00:06:06,950 --> 00:06:05,199
planet was warmer early on and something

155
00:06:09,270 --> 00:06:06,960
happened what we want to do is

156
00:06:11,270 --> 00:06:09,280
understand where did the water go where

157
00:06:12,870 --> 00:06:11,280
did the carbon dioxide from an early

158
00:06:14,870 --> 00:06:12,880
thick atmosphere go

159
00:06:16,469 --> 00:06:14,880
there are two places it can go it can go

160
00:06:19,350 --> 00:06:16,479
down into the crust where it can get

161
00:06:21,350 --> 00:06:19,360
locked up but we don't see the evidence

162
00:06:23,909 --> 00:06:21,360
for widespread

163
00:06:26,550 --> 00:06:23,919

abundant carbon-bearing minerals in the

164
00:06:28,550 --> 00:06:26,560
abundance necessary to be a reservoir

165
00:06:30,230 --> 00:06:28,560
for that thick early atmosphere

166
00:06:32,230 --> 00:06:30,240
the other place these could have gone is

167
00:06:34,469 --> 00:06:32,240
up to the top of the atmosphere where

168
00:06:35,590 --> 00:06:34,479
they could be stripped away and lost to

169
00:06:36,790 --> 00:06:35,600
space

170
00:06:39,270 --> 00:06:36,800
the

171
00:06:41,670 --> 00:06:39,280
removal process would involve forcing by

172
00:06:44,230 --> 00:06:41,680
the sun from

173
00:06:47,350 --> 00:06:44,240
solar wind from solar extreme

174
00:06:50,070 --> 00:06:47,360
ultraviolet photons from light waves

175
00:06:52,469 --> 00:06:50,080
from solar storms that might strip away

176
00:06:54,309 --> 00:06:52,479
gas from the top of the atmosphere maven

177
00:06:56,230 --> 00:06:54,319
is all about trying to understand these

178
00:06:57,909 --> 00:06:56,240
loss processes understand what could

179
00:07:00,230 --> 00:06:57,919
have happened at the top of the

180
00:07:01,430 --> 00:07:00,240
atmosphere and how gas could have been

181
00:07:03,990 --> 00:07:01,440
removed

182
00:07:06,150 --> 00:07:04,000
from it now we can't go back and study

183
00:07:07,830 --> 00:07:06,160
what happened over four billion years

184
00:07:10,309 --> 00:07:07,840
but we can go and look at how these

185
00:07:11,510 --> 00:07:10,319
processes are operating today and how

186
00:07:13,830 --> 00:07:11,520
they might have changed how the

187
00:07:15,510 --> 00:07:13,840
processes might have changed over time

188
00:07:17,670 --> 00:07:15,520

and what the integrated effect would

189
00:07:19,510 --> 00:07:17,680
have been can we go to the first graphic

190
00:07:20,390 --> 00:07:19,520
please

191
00:07:23,110 --> 00:07:20,400
we've

192
00:07:25,670 --> 00:07:23,120
selected eight instruments nine sensors

193
00:07:27,110 --> 00:07:25,680
so so there are nine boxes here

194
00:07:29,510 --> 00:07:27,120
to make the measurements we want to

195
00:07:31,510 --> 00:07:29,520
understand all the different

196
00:07:33,990 --> 00:07:31,520
connections in the chain from the

197
00:07:35,909 --> 00:07:34,000
energetic drivers to the response of the

198
00:07:38,550 --> 00:07:35,919
structure and composition of the upper

199
00:07:40,950 --> 00:07:38,560
atmosphere to the escape to space

200
00:07:43,749 --> 00:07:40,960
in the upper left on the chart here you

201
00:07:45,909 --> 00:07:43,759
see four instruments that are focused on

202
00:07:48,469 --> 00:07:45,919
measuring the energetic input from the

203
00:07:51,589 --> 00:07:48,479
sun the properties of the solar wind as

204
00:07:53,749 --> 00:07:51,599
it hits the atmosphere the solar extreme

205
00:07:56,550 --> 00:07:53,759
ultraviolet light waves

206
00:07:58,790 --> 00:07:56,560
and the solar storms each one of these

207
00:08:00,469 --> 00:07:58,800
is capable of driving processes that can

208
00:08:02,309 --> 00:08:00,479
lead to escape

209
00:08:03,670 --> 00:08:02,319
in the lower left you see the

210
00:08:05,909 --> 00:08:03,680
instruments that are going to be

211
00:08:07,270 --> 00:08:05,919
measuring the properties of the

212
00:08:10,150 --> 00:08:07,280
ionosphere

213
00:08:12,309 --> 00:08:10,160

the ions are created when solar light

214
00:08:13,510 --> 00:08:12,319
strips an electron off of an atom or a

215
00:08:15,909 --> 00:08:13,520
molecule

216
00:08:18,070 --> 00:08:15,919
and the ions have a specific set of

217
00:08:20,469 --> 00:08:18,080
processes that can lead to escape and we

218
00:08:21,990 --> 00:08:20,479
want to understand what those were

219
00:08:24,150 --> 00:08:22,000
in the lower right you see the

220
00:08:26,070 --> 00:08:24,160
instruments that measure the basic

221
00:08:28,390 --> 00:08:26,080
composition and structure of the upper

222
00:08:30,390 --> 00:08:28,400
atmosphere today and tell us about the

223
00:08:34,389 --> 00:08:30,400
things that can lead to escape

224
00:08:36,070 --> 00:08:34,399
with these nine sensors we're able to

225
00:08:38,949 --> 00:08:36,080
make all of the measurements that we

226
00:08:41,190 --> 00:08:38,959
need in order to understand what role

227
00:08:42,949 --> 00:08:41,200
has been played by escape to space if

228
00:08:46,070 --> 00:08:42,959
you go back to the graphic please i also

229
00:08:48,470 --> 00:08:46,080
wanted to focus on the spacecraft here

230
00:08:50,710 --> 00:08:48,480
the instruments are a raid around the

231
00:08:52,790 --> 00:08:50,720
spacecraft each one able to make the

232
00:08:54,949 --> 00:08:52,800
measurements that it needs at the same

233
00:08:56,550 --> 00:08:54,959
time so that we can get measurements

234
00:08:59,030 --> 00:08:56,560
throughout the orbit

235
00:09:02,389 --> 00:08:59,040
the instruments are at the end of the

236
00:09:04,550 --> 00:09:02,399
solar panels at the end of booms or

237
00:09:06,310 --> 00:09:04,560
an articulated platform at the bottom so

238
00:09:07,430 --> 00:09:06,320

that they can be oriented relative to

239
00:09:09,910 --> 00:09:07,440
the planet

240
00:09:11,750 --> 00:09:09,920
the spacecraft is in an elliptical orbit

241
00:09:13,910 --> 00:09:11,760
around the planet designed to allow us

242
00:09:16,230 --> 00:09:13,920
to make these measurements it goes from

243
00:09:18,949 --> 00:09:16,240
the lowest point in the orbit about 150

244
00:09:21,750 --> 00:09:18,959
kilometers altitude up to 6000

245
00:09:23,269 --> 00:09:21,760
kilometers from the high point we can we

246
00:09:25,509 --> 00:09:23,279
can make observations of the whole

247
00:09:27,509 --> 00:09:25,519
planet and we pass through the upper

248
00:09:29,269 --> 00:09:27,519
atmosphere on every orbit

249
00:09:30,949 --> 00:09:29,279
in addition five times during the

250
00:09:34,310 --> 00:09:30,959
mission we're going to lower that lowest

251
00:09:36,310 --> 00:09:34,320
point to 125 kilometers and that lets us

252
00:09:39,110 --> 00:09:36,320
sample the entire upper atmosphere all

253
00:09:40,550 --> 00:09:39,120
the way down to the well-mixed part

254
00:09:42,710 --> 00:09:40,560
where it connects to the lower

255
00:09:44,949 --> 00:09:42,720
atmosphere and all the way up to the top

256
00:09:46,470 --> 00:09:44,959
where it connects to the solar wind

257
00:09:49,190 --> 00:09:46,480
even though we're passing through the

258
00:09:50,949 --> 00:09:49,200
atmosphere it's so tenuous that it just

259
00:09:53,110 --> 00:09:50,959
doesn't create much drag on the

260
00:09:56,630 --> 00:09:53,120
spacecraft we'll feel it but it's not

261
00:09:58,070 --> 00:09:56,640
going to affect our orbit very much

262
00:10:00,710 --> 00:09:58,080
we're going to

263
00:10:02,790 --> 00:10:00,720

hear from the rest of the panelists from

264
00:10:04,710 --> 00:10:02,800
the deputy pi who's going to talk about

265
00:10:06,870 --> 00:10:04,720
some of the processes and we have three

266
00:10:08,550 --> 00:10:06,880
of the instrument leads to talk about

267
00:10:10,949 --> 00:10:08,560
how the measurements

268
00:10:13,590 --> 00:10:10,959
will will let us go to this question of

269
00:10:15,430 --> 00:10:13,600
how much gas has escaped over time

270
00:10:17,430 --> 00:10:15,440
so i'll turn it back to you george all

271
00:10:19,590 --> 00:10:17,440
right thank you bruce

272
00:10:22,230 --> 00:10:19,600
we'll talk now with janet lehman the

273
00:10:24,630 --> 00:10:22,240
maven deputy principal investigator from

274
00:10:25,750 --> 00:10:24,640
the university of california at berkeley

275
00:10:28,310 --> 00:10:25,760
janet

276
00:10:31,590 --> 00:10:28,320
thank you george if we can start with my

277
00:10:37,990 --> 00:10:34,630
the sun is a major player in this

278
00:10:40,069 --> 00:10:38,000
mission as bruce has said uh the earth

279
00:10:42,230 --> 00:10:40,079
is thought to have had its atmosphere

280
00:10:43,350 --> 00:10:42,240
protected somewhat by its magnetic

281
00:10:44,710 --> 00:10:43,360
bubble

282
00:10:47,509 --> 00:10:44,720
uh of a

283
00:10:50,550 --> 00:10:47,519
relatively strong internal field but

284
00:10:53,350 --> 00:10:50,560
mars only has very localized

285
00:10:55,590 --> 00:10:53,360
remnant magnetic fields that form small

286
00:10:58,389 --> 00:10:55,600
umbrellas of protection so that the

287
00:11:00,630 --> 00:10:58,399
atmosphere is more or less exposed most

288
00:11:03,509 --> 00:11:00,640

everywhere to the onslaught the direct

289
00:11:05,110 --> 00:11:03,519
onslaught of what's coming from the sun

290
00:11:07,750 --> 00:11:05,120
may i have the next

291
00:11:10,230 --> 00:11:07,760
slide please

292
00:11:12,790 --> 00:11:10,240
this is an illustration a very

293
00:11:15,829 --> 00:11:12,800
complicated one of what we think the

294
00:11:18,550 --> 00:11:15,839
various processes at work are in

295
00:11:19,990 --> 00:11:18,560
removing the atmosphere of mars at the

296
00:11:22,870 --> 00:11:20,000
current time

297
00:11:24,069 --> 00:11:22,880
and presumably throughout the history of

298
00:11:26,710 --> 00:11:24,079
mars

299
00:11:28,949 --> 00:11:26,720
since it settled down from its initial

300
00:11:31,590 --> 00:11:28,959
formation phases

301
00:11:34,550 --> 00:11:31,600
what we find is that it's a hugely

302
00:11:37,509 --> 00:11:34,560
complex system with a lot of inputs and

303
00:11:39,750 --> 00:11:37,519
outputs the sun is producing in addition

304
00:11:41,350 --> 00:11:39,760
to the radiation the photons it's

305
00:11:43,590 --> 00:11:41,360
producing these

306
00:11:45,509 --> 00:11:43,600
gusts of solar wind called coronal mass

307
00:11:46,710 --> 00:11:45,519
ejections it's producing energetic

308
00:11:50,389 --> 00:11:46,720
particles

309
00:11:53,670 --> 00:11:50,399
and mars is responding in various ways

310
00:11:56,230 --> 00:11:53,680
literally bristling with loss processes

311
00:11:58,150 --> 00:11:56,240
maven is instrumented specifically to be

312
00:11:59,590 --> 00:11:58,160
able to measure what's coming in and

313
00:12:01,110 --> 00:11:59,600

what's going out

314
00:12:04,389 --> 00:12:01,120
and how

315
00:12:07,590 --> 00:12:04,399
the output responds to the input

316
00:12:10,470 --> 00:12:07,600
this will allow us to estimate over long

317
00:12:12,389 --> 00:12:10,480
time periods of the order of billions of

318
00:12:13,509 --> 00:12:12,399
years which is the age of the solar

319
00:12:16,150 --> 00:12:13,519
system

320
00:12:18,150 --> 00:12:16,160
how long mars has been exposed to this

321
00:12:20,629 --> 00:12:18,160
kind of loss process and therefore how

322
00:12:23,269 --> 00:12:20,639
much atmosphere could have been

323
00:12:26,949 --> 00:12:23,279
removed in this way

324
00:12:32,949 --> 00:12:30,470
we are fortunate that the sun has been

325
00:12:33,990 --> 00:12:32,959
predictive in some sense

326
00:12:36,629 --> 00:12:34,000
we are

327
00:12:39,269 --> 00:12:36,639
going to be arriving at mars at the time

328
00:12:41,750 --> 00:12:39,279
of the blue arrow next september

329
00:12:43,350 --> 00:12:41,760
and the sun even though the sunspot

330
00:12:45,269 --> 00:12:43,360
number has been

331
00:12:47,190 --> 00:12:45,279
fairly modest by

332
00:12:48,550 --> 00:12:47,200
standards previous standards in the

333
00:12:51,430 --> 00:12:48,560
space age

334
00:12:53,350 --> 00:12:51,440
the sun has been quite productive of

335
00:12:56,470 --> 00:12:53,360
these conditions that you see on the

336
00:12:59,590 --> 00:12:56,480
right in the soho movie of coronal mass

337
00:13:01,269 --> 00:12:59,600
ejections which is a very recent movie

338
00:13:03,190 --> 00:13:01,279

giving you an idea of the fact that the

339
00:13:05,430 --> 00:13:03,200
sun is definitely not a

340
00:13:07,590 --> 00:13:05,440
quiet start this time

341
00:13:08,710 --> 00:13:07,600
we expect it to be active when maven

342
00:13:11,829 --> 00:13:08,720
arrives

343
00:13:14,069 --> 00:13:11,839
and we will be able to sense the arrival

344
00:13:15,509 --> 00:13:14,079
of these gusts of solar wind and all the

345
00:13:19,350 --> 00:13:15,519
associated

346
00:13:21,350 --> 00:13:19,360
particles and fields and

347
00:13:24,389 --> 00:13:21,360
hopefully understand the response of

348
00:13:27,350 --> 00:13:24,399
mars the early sun was supposedly more

349
00:13:29,110 --> 00:13:27,360
active than the current sun and so we

350
00:13:30,949 --> 00:13:29,120
expect that these active periods that

351
00:13:33,590 --> 00:13:30,959
we're seeing in the solar maximum will

352
00:13:35,750 --> 00:13:33,600
better represent uh the history of mars

353
00:13:37,190 --> 00:13:35,760
the early history of mars for our

354
00:13:39,030 --> 00:13:37,200
purposes of

355
00:13:40,870 --> 00:13:39,040
of going back in time

356
00:13:43,269 --> 00:13:40,880
and i will pass it back to you george

357
00:13:45,430 --> 00:13:43,279
all right thank you janet and now to

358
00:13:48,790 --> 00:13:45,440
begin our discussion of the instruments

359
00:13:51,030 --> 00:13:48,800
nick schneider the maven iuvs instrument

360
00:13:52,870 --> 00:13:51,040
lead from the laboratory for atmospheric

361
00:13:55,269 --> 00:13:52,880
and space physics at the university of

362
00:13:57,269 --> 00:13:55,279
colorado at boulder nick

363
00:13:59,269 --> 00:13:57,279

thank you george maven has two

364
00:14:02,629 --> 00:13:59,279
instruments on board that measure the

365
00:14:04,629 --> 00:14:02,639
composition and structure of the mars

366
00:14:06,470 --> 00:14:04,639
atmosphere and those instruments are the

367
00:14:07,350 --> 00:14:06,480
imaging ultraviolet spectrograph that i

368
00:14:08,629 --> 00:14:07,360
lead

369
00:14:10,629 --> 00:14:08,639
and the neutral gas ion mass

370
00:14:13,030 --> 00:14:10,639
spectrometer that you'll hear about next

371
00:14:14,710 --> 00:14:13,040
and these instruments operate in

372
00:14:16,550 --> 00:14:14,720
very different ways but they provide

373
00:14:18,629 --> 00:14:16,560
complementary information

374
00:14:20,710 --> 00:14:18,639
so i'll talk about how we figure out

375
00:14:23,590 --> 00:14:20,720
what's in the atmosphere and how it's

376
00:14:25,670 --> 00:14:23,600
distributed around the planet uh how and

377
00:14:27,670 --> 00:14:25,680
why we make those measurements and i'll

378
00:14:29,030 --> 00:14:27,680
be emphasizing the imaging ultraviolet

379
00:14:30,790 --> 00:14:29,040
spectrograph

380
00:14:32,870 --> 00:14:30,800
so our instrument takes advantage of the

381
00:14:35,269 --> 00:14:32,880
fact that the entire atmosphere is

382
00:14:37,829 --> 00:14:35,279
glowing at ultraviolet wavelengths and

383
00:14:39,590 --> 00:14:37,839
the graphic will explain how we can take

384
00:14:41,829 --> 00:14:39,600
advantage of that glow

385
00:14:43,509 --> 00:14:41,839
in order to understand where the what

386
00:14:45,350 --> 00:14:43,519
the atmosphere is made of if you could

387
00:14:47,350 --> 00:14:45,360
bring up that graphic

388
00:14:48,310 --> 00:14:47,360

if you run electricity through a tube of

389
00:14:50,310 --> 00:14:48,320
gas

390
00:14:52,790 --> 00:14:50,320
it glows this is the principle behind

391
00:14:54,550 --> 00:14:52,800
fluorescent lights and neon signs and

392
00:14:57,189 --> 00:14:54,560
the example that you see in the graphic

393
00:14:59,350 --> 00:14:57,199
is a tube of hydrogen gas and it to the

394
00:15:01,030 --> 00:14:59,360
eye it glows pink

395
00:15:02,870 --> 00:15:01,040
but if you spread that light out by

396
00:15:04,870 --> 00:15:02,880
looking through a prism or running it

397
00:15:07,670 --> 00:15:04,880
through an instrument like ours what you

398
00:15:10,230 --> 00:15:07,680
see is not the full rainbow of colors

399
00:15:12,550 --> 00:15:10,240
but just the specific colors

400
00:15:15,030 --> 00:15:12,560
at specific wavelengths of light and

401
00:15:18,870 --> 00:15:15,040
that is the spectroscopic signature it's

402
00:15:21,430 --> 00:15:18,880
the fingerprint of uh hydrogen gas and

403
00:15:23,670 --> 00:15:21,440
every gas has its own unique fingerprint

404
00:15:26,150 --> 00:15:23,680
so even from a distance when we take a

405
00:15:28,389 --> 00:15:26,160
spectrum of it we know what gases are

406
00:15:29,670 --> 00:15:28,399
there so wherever we look with our

407
00:15:31,990 --> 00:15:29,680
instrument we can figure out how much

408
00:15:33,990 --> 00:15:32,000
carbon dioxide how much oxygen how much

409
00:15:36,150 --> 00:15:34,000
hydrogen there is

410
00:15:37,509 --> 00:15:36,160
even off at a distance let me show you

411
00:15:43,990 --> 00:15:37,519
how this plays out

412
00:15:47,590 --> 00:15:45,749
and this is a model of the maven

413
00:15:49,749 --> 00:15:47,600

spacecraft it's about

414
00:15:51,749 --> 00:15:49,759
30 times smaller than

415
00:15:53,670 --> 00:15:51,759
the actual spacecraft

416
00:15:56,069 --> 00:15:53,680
and normally the spacecraft keeps the

417
00:15:58,150 --> 00:15:56,079
solar cells and instruments oriented

418
00:16:00,310 --> 00:15:58,160
towards the sun

419
00:16:03,269 --> 00:16:00,320
but so any instrument that we want to

420
00:16:06,310 --> 00:16:03,279
study the planet is mounted down here on

421
00:16:08,389 --> 00:16:06,320
this movable platform so

422
00:16:10,150 --> 00:16:08,399
whichever way the spacecraft has to move

423
00:16:11,990 --> 00:16:10,160
in its orbit

424
00:16:13,670 --> 00:16:12,000
and whichever way the spacecraft needs

425
00:16:15,990 --> 00:16:13,680
to be oriented

426
00:16:17,509 --> 00:16:16,000
we can ensure the proper direction for

427
00:16:20,710 --> 00:16:17,519
our observations

428
00:16:22,629 --> 00:16:20,720
now i think of ingims as the nose of the

429
00:16:25,189 --> 00:16:22,639
spacecraft it's right here

430
00:16:27,350 --> 00:16:25,199
and as it we skim down through the upper

431
00:16:29,910 --> 00:16:27,360
layers of the atmosphere

432
00:16:32,069 --> 00:16:29,920
end gims is basically sniffing atom by

433
00:16:33,829 --> 00:16:32,079
atom molecule by molecule to figure out

434
00:16:35,189 --> 00:16:33,839
what the composition of the atmosphere

435
00:16:36,710 --> 00:16:35,199
is right at the location of the

436
00:16:38,629 --> 00:16:36,720
spacecraft

437
00:16:40,710 --> 00:16:38,639
now at the same time

438
00:16:42,230 --> 00:16:40,720

our instrument

439
00:16:45,189 --> 00:16:42,240
is looking off to the side in the

440
00:16:45,990 --> 00:16:45,199
distance at the glowing atmosphere

441
00:16:47,590 --> 00:16:46,000
and

442
00:16:49,110 --> 00:16:47,600
not only can we look

443
00:16:51,590 --> 00:16:49,120
in a single direction but we have a

444
00:16:53,910 --> 00:16:51,600
moving mirror that allows us to scan up

445
00:16:56,629 --> 00:16:53,920
and down and see the composition of the

446
00:16:57,990 --> 00:16:56,639
atmosphere as a function of altitude and

447
00:17:00,310 --> 00:16:58,000
at times when we're far from the

448
00:17:02,790 --> 00:17:00,320
spacecraft we can actually map out those

449
00:17:05,029 --> 00:17:02,800
ingredients over the whole globe of the

450
00:17:07,270 --> 00:17:05,039
planet

451
00:17:08,390 --> 00:17:07,280
i can hand that over to you

452
00:17:11,189 --> 00:17:08,400
thanks

453
00:17:12,069 --> 00:17:11,199
careful got it

454
00:17:15,270 --> 00:17:12,079
so

455
00:17:18,230 --> 00:17:15,280
composition structure of the atmosphere

456
00:17:20,470 --> 00:17:18,240
is it reveals to us how much energy the

457
00:17:22,230 --> 00:17:20,480
atmosphere is receiving from the sun and

458
00:17:24,470 --> 00:17:22,240
at times when there's excess energy

459
00:17:26,949 --> 00:17:24,480
input in the form of those harsh

460
00:17:28,470 --> 00:17:26,959
ultraviolet photons or particles from

461
00:17:29,750 --> 00:17:28,480
the solar wind

462
00:17:31,190 --> 00:17:29,760
it has a number of effects on the

463
00:17:33,590 --> 00:17:31,200

atmosphere and the first thing that it

464
00:17:35,750 --> 00:17:33,600
does is it puffs up the atmosphere that

465
00:17:36,950 --> 00:17:35,760
extra energy heats it up

466
00:17:38,630 --> 00:17:36,960
and we can measure that with our

467
00:17:40,630 --> 00:17:38,640
instruments and the second thing that

468
00:17:42,470 --> 00:17:40,640
happens is that

469
00:17:43,990 --> 00:17:42,480
that excess energy causes chemical

470
00:17:45,270 --> 00:17:44,000
reactions and it can break apart

471
00:17:47,669 --> 00:17:45,280
molecules

472
00:17:48,789 --> 00:17:47,679
and it can strip the electrons off of

473
00:17:49,510 --> 00:17:48,799
atoms

474
00:17:54,070 --> 00:17:49,520
and

475
00:17:57,029 --> 00:17:54,080
that the excess energy

476
00:18:00,710 --> 00:17:57,039
in all these forms also causes extra

477
00:18:02,470 --> 00:18:00,720
atmospheric escape and so as uh we're

478
00:18:04,630 --> 00:18:02,480
we're making these measurements studying

479
00:18:07,110 --> 00:18:04,640
the proper properties of the atmosphere

480
00:18:09,270 --> 00:18:07,120
we're very sensitive to how the input

481
00:18:10,310 --> 00:18:09,280
conditions are leading to atmospheric

482
00:18:11,909 --> 00:18:10,320
escape

483
00:18:13,830 --> 00:18:11,919
now we'll be paying very close attention

484
00:18:15,750 --> 00:18:13,840
at the times that janet referred to of

485
00:18:17,830 --> 00:18:15,760
high solar activity

486
00:18:20,070 --> 00:18:17,840
because those are the times most

487
00:18:21,750 --> 00:18:20,080
representative of the early sun and so

488
00:18:23,669 --> 00:18:21,760

when we're measuring the escape rates

489
00:18:25,909 --> 00:18:23,679
during periods of high solar activity

490
00:18:28,470 --> 00:18:25,919
that's our best guess about how much

491
00:18:31,270 --> 00:18:28,480
atmospheric escape was occurring

492
00:18:33,350 --> 00:18:31,280
billions of years ago and we add up that

493
00:18:35,510 --> 00:18:33,360
level of atmospheric escape over time

494
00:18:37,669 --> 00:18:35,520
we'll have a good sense of just how much

495
00:18:39,669 --> 00:18:37,679
atmosphere mars lost through escape to

496
00:18:40,830 --> 00:18:39,679
space

497
00:18:42,630 --> 00:18:40,840
back to you

498
00:18:45,110 --> 00:18:42,640
george

499
00:18:46,870 --> 00:18:45,120
now to paul mahaffey the maven incomes

500
00:18:48,390 --> 00:18:46,880
instrument lead from nasa's goddard

501
00:18:49,990 --> 00:18:48,400
space flight center in greenbelt

502
00:18:51,270 --> 00:18:50,000
maryland paul

503
00:18:54,070 --> 00:18:51,280
thanks george

504
00:18:55,510 --> 00:18:54,080
delighted to support the mission with

505
00:18:57,350 --> 00:18:55,520
the provision of of the mass

506
00:18:58,549 --> 00:18:57,360
spectrometer to study the upper

507
00:19:00,710 --> 00:18:58,559
atmosphere

508
00:19:04,310 --> 00:19:00,720
of physics and chemistry to contribute

509
00:19:06,710 --> 00:19:04,320
to the study of atmospheric uh loss in

510
00:19:09,110 --> 00:19:06,720
in the current time and then ultimately

511
00:19:11,510 --> 00:19:09,120
to contribute to our understanding of

512
00:19:14,150 --> 00:19:11,520
ancient mars ancient climate and the

513
00:19:15,270 --> 00:19:14,160

habitability conditions on on ancient

514
00:19:17,270 --> 00:19:15,280
mars

515
00:19:18,549 --> 00:19:17,280
as nick mentioned we were kind of the

516
00:19:20,549 --> 00:19:18,559
the nose of the

517
00:19:22,230 --> 00:19:20,559
of the mission we have a mass

518
00:19:25,430 --> 00:19:22,240
spectrometer that

519
00:19:28,230 --> 00:19:25,440
as we uh go down in orbit to the lower

520
00:19:30,710 --> 00:19:28,240
altitudes primarily below 500 kilometers

521
00:19:32,150 --> 00:19:30,720
we measure both neutral gas uh i'll

522
00:19:34,630 --> 00:19:32,160
illustrate how we do that in just a

523
00:19:35,669 --> 00:19:34,640
second and then we also sample gases

524
00:19:40,470 --> 00:19:35,679
that

525
00:19:42,950 --> 00:19:40,480
solar radiation has produced and so we

526
00:19:47,190 --> 00:19:42,960
sample those both over the entire mass

527
00:19:49,029 --> 00:19:47,200
range of about two to 150 daltons to see

528
00:19:50,870 --> 00:19:49,039
what we get but we focus in on

529
00:19:52,710 --> 00:19:50,880
particular species that we believe are

530
00:19:54,870 --> 00:19:52,720
there that we want to get a higher

531
00:19:57,029 --> 00:19:54,880
spatial resolution with

532
00:19:59,510 --> 00:19:57,039
bruce selected an instrument payload

533
00:20:02,630 --> 00:19:59,520
that was very complementary

534
00:20:05,270 --> 00:20:02,640
as nick mentioned the uvs kind of gets

535
00:20:07,350 --> 00:20:05,280
the global view it'll be measuring

536
00:20:10,630 --> 00:20:07,360
things like carbon dioxide and molecular

537
00:20:13,190 --> 00:20:10,640
nitrogen atomic nitrogen atomic oxygen

538
00:20:15,350 --> 00:20:13,200

and so on and very much get a global

539
00:20:17,590 --> 00:20:15,360
view over the planet whereas we pretty

540
00:20:19,990 --> 00:20:17,600
much get a very detailed view but just

541
00:20:21,909 --> 00:20:20,000
along the spacecraft track so we'll be

542
00:20:24,230 --> 00:20:21,919
making measurements on every orbit as as

543
00:20:25,750 --> 00:20:24,240
we dip into the atmosphere and uh during

544
00:20:28,070 --> 00:20:25,760
these periods of the mission where we do

545
00:20:29,909 --> 00:20:28,080
those do the deep dips will get even

546
00:20:32,310 --> 00:20:29,919
more signal going down to the to the

547
00:20:34,230 --> 00:20:32,320
point where the atmosphere is well mixed

548
00:20:35,830 --> 00:20:34,240
we're also very complementary to the

549
00:20:38,149 --> 00:20:35,840
fields and particle

550
00:20:40,950 --> 00:20:38,159
suite of instruments for example the

551
00:20:42,950 --> 00:20:40,960
static instrument measures a range of

552
00:20:45,909 --> 00:20:42,960
energies of ions

553
00:20:48,630 --> 00:20:45,919
up to very high energies and we measure

554
00:20:50,950 --> 00:20:48,640
the composition of ions as well at lower

555
00:20:54,310 --> 00:20:50,960
altitudes but

556
00:20:55,590 --> 00:20:54,320
at the lower energies so the uvs the the

557
00:20:56,870 --> 00:20:55,600
static experiment and the mass

558
00:21:00,390 --> 00:20:56,880
spectrometer

559
00:21:02,950 --> 00:21:00,400
all complement each other uh very nicely

560
00:21:05,270 --> 00:21:02,960
we're interested particularly in

561
00:21:07,350 --> 00:21:05,280
uh how the

562
00:21:10,390 --> 00:21:07,360
spatial distribution of these atoms and

563
00:21:12,149 --> 00:21:10,400

molecules changes with altitude and that

564
00:21:13,909 --> 00:21:12,159
really ties to these processes of

565
00:21:17,110 --> 00:21:13,919
atmospheric escape

566
00:21:19,990 --> 00:21:17,120
let me give you one example

567
00:21:22,789 --> 00:21:20,000
we have for example with the curiosity

568
00:21:25,270 --> 00:21:22,799
rover measured a suite of atoms and

569
00:21:26,390 --> 00:21:25,280
molecules in the well-mixed atmosphere

570
00:21:28,390 --> 00:21:26,400
and one

571
00:21:30,390 --> 00:21:28,400
atomic species is particularly

572
00:21:32,470 --> 00:21:30,400
interesting is argon

573
00:21:35,909 --> 00:21:32,480
the primordial isotopes of argon are

574
00:21:39,190 --> 00:21:35,919
argon 36 and argon 38 and of course the

575
00:21:41,990 --> 00:21:39,200
38 is a little bit heavier the 36 is

576
00:21:44,390 --> 00:21:42,000
lighter so it ends up going up higher in

577
00:21:46,870 --> 00:21:44,400
the atmosphere on average and it escapes

578
00:21:48,230 --> 00:21:46,880
easier so over billions and billions of

579
00:21:50,070 --> 00:21:48,240
years

580
00:21:52,870 --> 00:21:50,080
you leave more of the heavy stuff in the

581
00:21:54,549 --> 00:21:52,880
atmosphere and so we measure that both

582
00:21:56,710 --> 00:21:54,559
with surface landers we measure that

583
00:21:58,710 --> 00:21:56,720
with curiosity but we'll really get an

584
00:22:00,390 --> 00:21:58,720
idea of the distribution of these things

585
00:22:02,950 --> 00:22:00,400
in the upper atmosphere

586
00:22:05,110 --> 00:22:02,960
with our maven engines experiment

587
00:22:07,669 --> 00:22:05,120
so i have to show a picture of the

588
00:22:09,510 --> 00:22:07,679

instrument developed by our talented

589
00:22:11,430 --> 00:22:09,520
engineering team at goddard

590
00:22:13,669 --> 00:22:11,440
what you see on the left is

591
00:22:15,669 --> 00:22:13,679
actually a protective cap

592
00:22:17,029 --> 00:22:15,679
for a break off when we get into orbit

593
00:22:18,950 --> 00:22:17,039
around mars

594
00:22:20,870 --> 00:22:18,960
we'll fire a pyrotechnic that cap will

595
00:22:23,510 --> 00:22:20,880
come flying off and eventually land on

596
00:22:25,510 --> 00:22:23,520
mars but then the ma the ionization

597
00:22:27,190 --> 00:22:25,520
source of the mass spectrometer

598
00:22:29,270 --> 00:22:27,200
will be exposed

599
00:22:31,669 --> 00:22:29,280
and on the second graphic i'll just

600
00:22:33,270 --> 00:22:31,679
remake the point that

601
00:22:35,270 --> 00:22:33,280
you know we're down on the surface with

602
00:22:37,669 --> 00:22:35,280
our rovers with

603
00:22:39,990 --> 00:22:37,679
opportunity now roving on one part of

604
00:22:42,870 --> 00:22:40,000
the planet and curiosity shown in the

605
00:22:45,110 --> 00:22:42,880
left left graphic on the left and the

606
00:22:46,789 --> 00:22:45,120
study of mars really is a program you

607
00:22:49,510 --> 00:22:46,799
you need to look at things both in

608
00:22:50,710 --> 00:22:49,520
detail on the surface and understand

609
00:22:52,390 --> 00:22:50,720
what's happening with the upper

610
00:22:54,870 --> 00:22:52,400
atmosphere to really get at the history

611
00:22:57,270 --> 00:22:54,880
of the planet and so

612
00:22:59,909 --> 00:22:57,280
in fact we have a mass spectrometer on

613
00:23:01,669 --> 00:22:59,919

curiosity it's in in the sam suite and

614
00:23:03,669 --> 00:23:01,679
the advantage of being on the surface is

615
00:23:05,590 --> 00:23:03,679
we can not only look at

616
00:23:07,669 --> 00:23:05,600
gases that were trapped in an ancient

617
00:23:09,029 --> 00:23:07,679
environment that we released by heating

618
00:23:11,190 --> 00:23:09,039
but we can measure the current

619
00:23:13,590 --> 00:23:11,200
atmosphere very very carefully and with

620
00:23:16,070 --> 00:23:13,600
high precision so for example in that

621
00:23:17,430 --> 00:23:16,080
argon isotope measurement that i just

622
00:23:20,310 --> 00:23:17,440
described

623
00:23:22,789 --> 00:23:20,320
we were able to get a very precise ratio

624
00:23:25,990 --> 00:23:22,799
of argon 36 to 38 it turns out to be

625
00:23:27,830 --> 00:23:26,000
about 4.2 very precise number

626
00:23:29,909 --> 00:23:27,840
and that's really different than any

627
00:23:32,230 --> 00:23:29,919
place else we know of in the solar

628
00:23:33,830 --> 00:23:32,240
system and these are primordial argon

629
00:23:36,549 --> 00:23:33,840
isotopes and that's just really a

630
00:23:38,870 --> 00:23:36,559
signature of the lighter argon having

631
00:23:40,870 --> 00:23:38,880
escaped over billions of years easier

632
00:23:43,750 --> 00:23:40,880
than the heavier

633
00:23:46,310 --> 00:23:43,760
argon and so we'll be looking at a range

634
00:23:48,230 --> 00:23:46,320
of isotopes and chemistries that go on

635
00:23:51,190 --> 00:23:48,240
in the upper atmosphere

636
00:23:53,830 --> 00:23:51,200
with our maven mass spectrometer as well

637
00:23:56,230 --> 00:23:53,840
so what i'll end up with is just a

638
00:23:59,350 --> 00:23:56,240

little bit of a of a snapshot uh with a

639
00:24:01,590 --> 00:23:59,360
video uh which you can look at now of

640
00:24:03,590 --> 00:24:01,600
how the mass spectrometer works so this

641
00:24:05,830 --> 00:24:03,600
is basically a metal case and what you

642
00:24:07,750 --> 00:24:05,840
see here is an electron beam an

643
00:24:11,029 --> 00:24:07,760
illustration of electron beam that's

644
00:24:13,990 --> 00:24:11,039
ionizing the neutral gas in this case uh

645
00:24:16,310 --> 00:24:14,000
it sees a molecule in the beam it breaks

646
00:24:19,029 --> 00:24:16,320
it apart it creates an ion from a

647
00:24:21,750 --> 00:24:19,039
neutral gas that ion then gets focused

648
00:24:23,909 --> 00:24:21,760
into into a quadrupole filter it's a set

649
00:24:25,990 --> 00:24:23,919
of four rods and as the

650
00:24:27,909 --> 00:24:26,000
ions spiral down the rods they get

651
00:24:29,750 --> 00:24:27,919
separated out by mass they hit a

652
00:24:31,510 --> 00:24:29,760
detector you count the number of ions

653
00:24:33,029 --> 00:24:31,520
that come through at a particular mass

654
00:24:35,430 --> 00:24:33,039
and you have what's what's called a mass

655
00:24:37,750 --> 00:24:35,440
spectrum and that's how we measure the

656
00:24:40,149 --> 00:24:37,760
the composition of the upper atmosphere

657
00:24:41,590 --> 00:24:40,159
so that's how our instrument endems

658
00:24:44,149 --> 00:24:41,600
works and with that we'll pass it back

659
00:24:46,149 --> 00:24:44,159
to george all right thank you paul and

660
00:24:48,230 --> 00:24:46,159
following on to complete our discussion

661
00:24:50,630 --> 00:24:48,240
of the instruments is david l mitchell

662
00:24:52,789 --> 00:24:50,640
the maven swia instrument lead from the

663
00:24:53,669 --> 00:24:52,799

university of california at berkeley

664
00:24:55,590 --> 00:24:53,679
david

665
00:24:57,190 --> 00:24:55,600
thank you george i'm going to talk about

666
00:24:59,990 --> 00:24:57,200
just a couple of the processes that

667
00:25:01,669 --> 00:25:00,000
janet showed on her complicated graphic

668
00:25:03,669 --> 00:25:01,679
in the simplest terms

669
00:25:05,510 --> 00:25:03,679
an atmospheric species at mars has to

670
00:25:06,630 --> 00:25:05,520
attain escape velocity to leave the

671
00:25:08,470 --> 00:25:06,640
planet

672
00:25:10,390 --> 00:25:08,480
for neutrals this can occur via

673
00:25:12,710 --> 00:25:10,400
exothermic chemical reactions in the

674
00:25:14,470 --> 00:25:12,720
atmosphere and also by impact by

675
00:25:16,710 --> 00:25:14,480
energetic ions may have the first

676
00:25:19,029 --> 00:25:16,720
graphic please

677
00:25:20,710 --> 00:25:19,039
for ions on the other hand these are

678
00:25:23,029 --> 00:25:20,720
charged particles and so they can be

679
00:25:25,029 --> 00:25:23,039
accelerated by electric fields arising

680
00:25:27,110 --> 00:25:25,039
from the interaction of the solar wind

681
00:25:29,510 --> 00:25:27,120
with the martian ionosphere and with its

682
00:25:31,430 --> 00:25:29,520
crustal magnetic fields

683
00:25:33,990 --> 00:25:31,440
however these same crystal magnetic

684
00:25:36,070 --> 00:25:34,000
fields can form closed loops and trap

685
00:25:37,990 --> 00:25:36,080
the plasma on these closed loops so that

686
00:25:39,830 --> 00:25:38,000
it cannot escape

687
00:25:42,230 --> 00:25:39,840
nearby magnetic field lines are open to

688
00:25:45,110 --> 00:25:42,240

the solar wind and they allow ionos or

689
00:25:47,510 --> 00:25:45,120
plasma ionospheric ions to go out into

690
00:25:49,669 --> 00:25:47,520
space and be lost

691
00:25:51,590 --> 00:25:49,679
if it's a two-way street it also allows

692
00:25:52,470 --> 00:25:51,600
the solar wind plasma to precipitate

693
00:25:56,390 --> 00:25:52,480
down

694
00:25:57,590 --> 00:25:56,400
and heat the ionosphere below

695
00:26:00,470 --> 00:25:57,600
on maven

696
00:26:03,269 --> 00:26:00,480
we'd like the the

697
00:26:05,990 --> 00:26:03,279
formation of these regions of open field

698
00:26:07,029 --> 00:26:06,000
lines are analogous to auroral zones on

699
00:26:09,669 --> 00:26:07,039
earth

700
00:26:11,269 --> 00:26:09,679
and it's a dynamic process and the for

701
00:26:13,510 --> 00:26:11,279
they open and close as the planet

702
00:26:16,470 --> 00:26:13,520
rotates and as the solar wind magnetic

703
00:26:17,750 --> 00:26:16,480
field changes strength and polarity

704
00:26:20,470 --> 00:26:17,760
on maven

705
00:26:22,710 --> 00:26:20,480
the sui and the mag instruments are

706
00:26:24,549 --> 00:26:22,720
designed to map out the crystal magnetic

707
00:26:26,630 --> 00:26:24,559
fields and determine whether or not

708
00:26:28,310 --> 00:26:26,640
they're open and closed

709
00:26:30,789 --> 00:26:28,320
the magnetometer measures the field's

710
00:26:32,950 --> 00:26:30,799
strength and direction and swia measures

711
00:26:34,630 --> 00:26:32,960
electrons flowing along that field line

712
00:26:35,990 --> 00:26:34,640
to determine whether or not the field is

713
00:26:37,350 --> 00:26:36,000

open or closed

714
00:26:38,950 --> 00:26:37,360
and this sets the stage for the

715
00:26:42,710 --> 00:26:38,960
interpretation of all the plasma

716
00:26:45,510 --> 00:26:43,750
however

717
00:26:47,750 --> 00:26:45,520
this is a region with strong crystal

718
00:26:49,269 --> 00:26:47,760
magnetic fields and mars does not have

719
00:26:51,750 --> 00:26:49,279
strong coastal magnetic fields over the

720
00:26:53,430 --> 00:26:51,760
entire surface there are large regions

721
00:26:55,350 --> 00:26:53,440
particularly in the northern hemisphere

722
00:26:57,909 --> 00:26:55,360
where there are very negligible crystal

723
00:26:59,750 --> 00:26:57,919
magnetic fields and in these regions the

724
00:27:01,990 --> 00:26:59,760
solar wind is able to interact directly

725
00:27:04,630 --> 00:27:02,000
with the martian ionosphere

726
00:27:06,390 --> 00:27:04,640
one of the key regions for ion loss is

727
00:27:09,029 --> 00:27:06,400
the interface between the solar wind and

728
00:27:11,510 --> 00:27:09,039
the top of the ionosphere in this region

729
00:27:13,590 --> 00:27:11,520
the ion density is relatively high and

730
00:27:16,149 --> 00:27:13,600
acceleration to escape velocity can lead

731
00:27:21,190 --> 00:27:16,159
to significant ionospheric loss

732
00:27:26,310 --> 00:27:24,149
here we see a simulation of ion loss

733
00:27:28,389 --> 00:27:26,320
from the top of the ionosphere at mars

734
00:27:29,350 --> 00:27:28,399
you actually see two processes at work

735
00:27:33,750 --> 00:27:29,360
here

736
00:27:35,350 --> 00:27:33,760
by that solar wind as it flows past the

737
00:27:38,630 --> 00:27:35,360
planet those are illustrated by the

738
00:27:39,590 --> 00:27:38,640

white arrows that are shimmying around

739
00:27:40,870 --> 00:27:39,600
of

740
00:27:43,350 --> 00:27:40,880
interest here

741
00:27:45,430 --> 00:27:43,360
is the plasma instabilities that arise

742
00:27:47,110 --> 00:27:45,440
at the solar wind ionosphere interface

743
00:27:49,430 --> 00:27:47,120
and you can see those at the bottom

744
00:27:51,669 --> 00:27:49,440
where large portions of the upper

745
00:27:55,909 --> 00:27:51,679
ionosphere are literally stripped away

746
00:27:59,190 --> 00:27:57,110
so

747
00:28:00,470 --> 00:27:59,200
on maven we have a suite of instruments

748
00:28:03,029 --> 00:28:00,480
that are designed to study this

749
00:28:04,789 --> 00:28:03,039
interface in detail the sway instrument

750
00:28:06,950 --> 00:28:04,799
measures the flow of the solar wind as

751
00:28:09,669 --> 00:28:06,960
it passes by the planet

752
00:28:10,950 --> 00:28:09,679
swea mag and lpw study the structure of

753
00:28:13,190 --> 00:28:10,960
the interface

754
00:28:14,830 --> 00:28:13,200
and static measures the composition and

755
00:28:17,110 --> 00:28:14,840
velocity of ions as they leave the

756
00:28:19,029 --> 00:28:17,120
planet so our goal here is to try to

757
00:28:21,029 --> 00:28:19,039
understand the importance of these kinds

758
00:28:22,630 --> 00:28:21,039
of processes to the overall loss of

759
00:28:24,070 --> 00:28:22,640
atmosphere at mars

760
00:28:27,909 --> 00:28:24,080
and with that i will pass it back to you

761
00:28:32,789 --> 00:28:30,789
and we're ready now to take questions

762
00:28:37,590 --> 00:28:32,799
please give your name an affiliation

763
00:28:41,029 --> 00:28:39,029

questions over here

764
00:28:44,149 --> 00:28:41,039
all right right here in the front

765
00:28:46,389 --> 00:28:44,159
hi um i'm miriam kramer with space.com

766
00:28:47,990 --> 00:28:46,399
i'm wondering uh the instruments i think

767
00:28:49,909 --> 00:28:48,000
are supposed to be turned on about two

768
00:28:52,310 --> 00:28:49,919
weeks into the flight

769
00:28:55,029 --> 00:28:52,320
and i'm curious if there will be any

770
00:28:56,830 --> 00:28:55,039
measurements taken and route to mars and

771
00:29:00,310 --> 00:28:56,840
what those measurements might

772
00:29:01,990 --> 00:29:00,320
be let me let me start

773
00:29:03,750 --> 00:29:02,000
we're going to turn the instruments on

774
00:29:05,029 --> 00:29:03,760
to check them out make sure they

775
00:29:06,470 --> 00:29:05,039
survived

776
00:29:09,029 --> 00:29:06,480
the

777
00:29:11,510 --> 00:29:09,039
launch successfully

778
00:29:13,990 --> 00:29:11,520
that's the the primary focus of getting

779
00:29:15,830 --> 00:29:14,000
them on as soon as possible

780
00:29:18,310 --> 00:29:15,840
some of them will be taking measurements

781
00:29:21,029 --> 00:29:18,320
during the cruise phase

782
00:29:23,430 --> 00:29:21,039
we'll be doing observations of the sun

783
00:29:25,110 --> 00:29:23,440
in order to compare with the earth and

784
00:29:26,950 --> 00:29:25,120
nick do you want to say something about

785
00:29:28,950 --> 00:29:26,960
observations of comet possible

786
00:29:30,630 --> 00:29:28,960
observations of comet ison

787
00:29:33,110 --> 00:29:30,640
sure i'd be happy to

788
00:29:36,070 --> 00:29:33,120

if we launch on time and if the top

789
00:29:38,070 --> 00:29:36,080
priority of the trajectory correction

790
00:29:40,389 --> 00:29:38,080
and all the other checkouts go okay

791
00:29:42,389 --> 00:29:40,399
we'll have the opportunity to use our

792
00:29:45,029 --> 00:29:42,399
ultraviolet imaging spectrograph on

793
00:29:47,350 --> 00:29:45,039
comet ison many of the same gases that

794
00:29:50,630 --> 00:29:47,360
are present in the mars atmosphere are

795
00:29:53,750 --> 00:29:50,640
also present in comets and so what an

796
00:29:55,909 --> 00:29:53,760
ideal opportunity for us to

797
00:29:57,590 --> 00:29:55,919
try out our instrument and do some good

798
00:29:59,269 --> 00:29:57,600
science along the way

799
00:30:02,389 --> 00:29:59,279
we're crossing our fingers of course

800
00:30:03,990 --> 00:30:02,399
about the the successful launch and

801
00:30:05,269 --> 00:30:04,000
successful checkout

802
00:30:06,789 --> 00:30:05,279
but we should

803
00:30:08,789 --> 00:30:06,799
if we have the time get some really

804
00:30:11,430 --> 00:30:08,799
great observations in the ultraviolet of

805
00:30:13,750 --> 00:30:11,440
comet ison

806
00:30:15,590 --> 00:30:13,760
bill uh bill harwood cbs for i'm not

807
00:30:18,149 --> 00:30:15,600
sure who to ask this to but when we're

808
00:30:19,269 --> 00:30:18,159
talking about these methods or ways that

809
00:30:20,870 --> 00:30:19,279
the atmosphere gets tripped out i'm a

810
00:30:23,350 --> 00:30:20,880
little unclear about how all those work

811
00:30:25,190 --> 00:30:23,360
on earth is the magnetic field

812
00:30:27,590 --> 00:30:25,200
the the predominant thing that prevents

813
00:30:28,630 --> 00:30:27,600

that same sort of escape or

814
00:30:30,149 --> 00:30:28,640
i don't know how much gas gets

815
00:30:31,990 --> 00:30:30,159
replenished in earth's atmosphere from

816
00:30:33,430 --> 00:30:32,000
the geology that's one question was just

817
00:30:35,029 --> 00:30:33,440
comparing the two a little better to

818
00:30:36,789 --> 00:30:35,039
explain it

819
00:30:37,909 --> 00:30:36,799
would you like me to take it

820
00:30:39,990 --> 00:30:37,919
uh

821
00:30:42,630 --> 00:30:40,000
this is a subject of debate in the

822
00:30:45,350 --> 00:30:42,640
science community in fact uh whether the

823
00:30:47,909 --> 00:30:45,360
presence of a magnetic field uh does

824
00:30:49,269 --> 00:30:47,919
shield a planetary atmosphere

825
00:30:51,430 --> 00:30:49,279
the um

826
00:30:53,750 --> 00:30:51,440
the workings of the escape there there

827
00:30:56,230 --> 00:30:53,760
is escape in both cases the workings of

828
00:30:59,269 --> 00:30:56,240
the escape processes are different

829
00:31:00,230 --> 00:30:59,279
in uh in the earth's case for example

830
00:31:04,710 --> 00:31:00,240
the

831
00:31:06,789 --> 00:31:04,720
solar wind impact

832
00:31:09,110 --> 00:31:06,799
but some of the energy is channeled into

833
00:31:11,990 --> 00:31:09,120
the polar regions mainly

834
00:31:13,190 --> 00:31:12,000
and so there's a focus of of the energy

835
00:31:16,470 --> 00:31:13,200
that

836
00:31:19,430 --> 00:31:16,480
helps produce things like the aurora

837
00:31:21,430 --> 00:31:19,440
and also geomagnetic storms uh can be

838
00:31:24,870 --> 00:31:21,440

produced by the impact of some of these

839
00:31:27,190 --> 00:31:24,880
coronal mass ejection uh pressure pulses

840
00:31:29,750 --> 00:31:27,200
uh so there's energizations going on but

841
00:31:31,590 --> 00:31:29,760
they're different kinds of energizations

842
00:31:33,430 --> 00:31:31,600
and so uh

843
00:31:34,710 --> 00:31:33,440
the way it works in the earth is that

844
00:31:37,430 --> 00:31:34,720
the energy

845
00:31:40,310 --> 00:31:37,440
gets into the polar regions stirs up

846
00:31:42,389 --> 00:31:40,320
heats the ions and then they flow out of

847
00:31:44,950 --> 00:31:42,399
the polar cap and then they have to make

848
00:31:47,029 --> 00:31:44,960
their way out of the magnetosphere

849
00:31:49,430 --> 00:31:47,039
so even though there's a

850
00:31:51,669 --> 00:31:49,440
an energy input and a heating process

851
00:31:55,990 --> 00:31:51,679
it's focused into the high latitude

852
00:31:58,070 --> 00:31:56,000
regions it heats and uh the ions that

853
00:32:00,310 --> 00:31:58,080
are heated have to run the gauntlet to

854
00:32:01,269 --> 00:32:00,320
find paths out of the magnetosphere

855
00:32:02,870 --> 00:32:01,279
however

856
00:32:05,269 --> 00:32:02,880
estimates are that the current day

857
00:32:06,870 --> 00:32:05,279
escape rate for an important element

858
00:32:09,990 --> 00:32:06,880
such as oxygen

859
00:32:12,789 --> 00:32:10,000
and oxygen ions at the earth is is

860
00:32:15,190 --> 00:32:12,799
presently comparable to what's been

861
00:32:17,029 --> 00:32:15,200
measured at mars by the mars express

862
00:32:18,549 --> 00:32:17,039
spacecraft and the earlier phobos

863
00:32:21,430 --> 00:32:18,559

spacecraft

864
00:32:23,990 --> 00:32:21,440
so current day rates of oxygen loss

865
00:32:27,110 --> 00:32:24,000
anyway are comparable

866
00:32:31,590 --> 00:32:27,120
what we want to to determine is whether

867
00:32:34,070 --> 00:32:31,600
the the rates scale with solar inputs

868
00:32:35,909 --> 00:32:34,080
in a different way at mars where we have

869
00:32:37,990 --> 00:32:35,919
the direct interaction

870
00:32:41,029 --> 00:32:38,000
uh with the upper atmosphere rather than

871
00:32:43,029 --> 00:32:41,039
the filtering by the magnetosphere

872
00:32:45,029 --> 00:32:43,039
one more quick one um if i could follow

873
00:32:46,310 --> 00:32:45,039
up on the answers around that uh i'd

874
00:32:48,470 --> 00:32:46,320
like to point out that one of the

875
00:32:50,470 --> 00:32:48,480
processes that bruce mentioned uh was

876
00:32:51,990 --> 00:32:50,480
suspected at mars uh has definitely

877
00:32:54,389 --> 00:32:52,000
occurred on earth and that's the

878
00:32:56,630 --> 00:32:54,399
absorption of atmospheric ingredients uh

879
00:32:58,070 --> 00:32:56,640
into the planet into the crust itself

880
00:33:00,789 --> 00:32:58,080
and so that's where most of the carbon

881
00:33:02,310 --> 00:33:00,799
dioxide given off by volcanoes has ended

882
00:33:03,830 --> 00:33:02,320
up on earth

883
00:33:05,669 --> 00:33:03,840
and so that process has definitely

884
00:33:07,509 --> 00:33:05,679
changed our atmosphere here

885
00:33:08,870 --> 00:33:07,519
the other thing i wanted to emphasize

886
00:33:10,630 --> 00:33:08,880
that even though

887
00:33:12,389 --> 00:33:10,640
we do know that atmospheric escape is

888
00:33:15,029 --> 00:33:12,399

happening from the earth

889
00:33:17,990 --> 00:33:15,039
there's no way that our atmosphere

890
00:33:20,070 --> 00:33:18,000
will will lose the habitability of our

891
00:33:21,590 --> 00:33:20,080
planet we have both a magnetic field and

892
00:33:23,350 --> 00:33:21,600
strong gravity

893
00:33:24,470 --> 00:33:23,360
so it's a very different story for mars

894
00:33:26,389 --> 00:33:24,480
in the past

895
00:33:28,310 --> 00:33:26,399
thanks and uh just to i don't know if

896
00:33:30,310 --> 00:33:28,320
you can answer this tonight is is mars

897
00:33:31,909 --> 00:33:30,320
today would you guess but not as part of

898
00:33:32,710 --> 00:33:31,919
the reason for the mission but

899
00:33:35,830 --> 00:33:32,720
is it

900
00:33:37,350 --> 00:33:35,840
some lower limit to where you wouldn't

901
00:33:39,110 --> 00:33:37,360
expect to lose a lot more and it would

902
00:33:41,509 --> 00:33:39,120
just stay there or could you lose it all

903
00:33:44,630 --> 00:33:41,519
if if enough time goes by

904
00:33:45,590 --> 00:33:44,640
what has happened on mars is that

905
00:33:47,350 --> 00:33:45,600
the

906
00:33:49,990 --> 00:33:47,360
most intense loss is thought to have

907
00:33:53,269 --> 00:33:50,000
occurred early in the history when the

908
00:33:56,310 --> 00:33:53,279
sun the solar wind were more intense

909
00:33:58,789 --> 00:33:56,320
the loss rates today are low enough

910
00:34:00,710 --> 00:33:58,799
that we're probably not seeing

911
00:34:03,029 --> 00:34:00,720
not going to see the loss of the entire

912
00:34:04,870 --> 00:34:03,039
atmosphere the reason we're studying it

913
00:34:07,190 --> 00:34:04,880

today even though the loss rates are so

914
00:34:09,190 --> 00:34:07,200
much lower is that we can understand the

915
00:34:11,270 --> 00:34:09,200
specific processes

916
00:34:15,190 --> 00:34:11,280
that are going on and learn how to

917
00:34:24,950 --> 00:34:17,990
do you have any additional comments

918
00:34:29,589 --> 00:34:26,869
frank mooring with aviation week i think

919
00:34:31,909 --> 00:34:29,599
this is for bruce um nick mentioned that

920
00:34:33,510 --> 00:34:31,919
there's you're using some data or

921
00:34:36,869 --> 00:34:33,520
comparing some

922
00:34:38,310 --> 00:34:36,879
isotope data from curiosity i wonder is

923
00:34:40,550 --> 00:34:38,320
there any

924
00:34:43,589 --> 00:34:40,560
specific coordination planned among the

925
00:34:45,829 --> 00:34:43,599
various spacecraft

926
00:34:46,629 --> 00:34:45,839
at mars with maven

927
00:34:54,869 --> 00:34:46,639
we

928
00:34:57,510 --> 00:34:54,879
is that mars is actually a very

929
00:34:59,589 --> 00:34:57,520
complicated system we've gone beyond the

930
00:35:00,550 --> 00:34:59,599
ability to look at one part of the

931
00:35:02,550 --> 00:35:00,560
planet

932
00:35:04,870 --> 00:35:02,560
and understand everything there is to

933
00:35:07,030 --> 00:35:04,880
know about it the atmosphere connects to

934
00:35:09,750 --> 00:35:07,040
the upper atmosphere and to the the

935
00:35:13,109 --> 00:35:09,760
solar wind and loss to space it connects

936
00:35:14,310 --> 00:35:13,119
to the surface the polar caps the deep

937
00:35:16,150 --> 00:35:14,320
interior

938
00:35:17,670 --> 00:35:16,160

so we need to understand all parts of it

939
00:35:19,829 --> 00:35:17,680
and that requires

940
00:35:23,190 --> 00:35:19,839
uh comparing observations from different

941
00:35:25,109 --> 00:35:23,200
spacecraft with curiosity as paul

942
00:35:26,390 --> 00:35:25,119
mentioned we're comparing the isotopes

943
00:35:28,790 --> 00:35:26,400
we're going to measure at the top with

944
00:35:30,790 --> 00:35:28,800
the isotopes at the bottom we don't need

945
00:35:33,750 --> 00:35:30,800
to do any specific coordination because

946
00:35:35,349 --> 00:35:33,760
both spacecraft are going to be working

947
00:35:37,910 --> 00:35:35,359
uh doing their own thing and we can

948
00:35:39,510 --> 00:35:37,920
compare the data after the fact where we

949
00:35:41,829 --> 00:35:39,520
think we can do the most valuable

950
00:35:44,630 --> 00:35:41,839
coordination is with the european space

951
00:35:45,990 --> 00:35:44,640
agency mars express mission because they

952
00:35:48,310 --> 00:35:46,000
have several instruments that are

953
00:35:51,109 --> 00:35:48,320
measuring things very closely related to

954
00:35:52,550 --> 00:35:51,119
the things we're measuring and we want

955
00:35:54,790 --> 00:35:52,560
to make sure that we're getting the

956
00:35:57,270 --> 00:35:54,800
right observations at the right time to

957
00:35:59,190 --> 00:35:57,280
be able to do that cross-coordination

958
00:36:00,710 --> 00:35:59,200
we have a working group

959
00:36:02,710 --> 00:36:00,720
made up of members of our team and

960
00:36:05,750 --> 00:36:02,720
members of their team for the specific

961
00:36:08,790 --> 00:36:05,760
purpose of doing that coordination

962
00:36:11,829 --> 00:36:08,800
we've also approached the

963
00:36:13,829 --> 00:36:11,839

indian space mission to mars mongalian

964
00:36:15,589 --> 00:36:13,839
in order to discuss whether there should

965
00:36:17,030 --> 00:36:15,599
be coordination there

966
00:36:18,470 --> 00:36:17,040
because they also have a couple of

967
00:36:19,829 --> 00:36:18,480
instruments that make relevant

968
00:36:21,589 --> 00:36:19,839
measurements to what we're doing and

969
00:36:23,829 --> 00:36:21,599
vice versa

970
00:36:26,390 --> 00:36:23,839
there we've agreed that after we're both

971
00:36:29,430 --> 00:36:26,400
in orbit taking data we'll figure out

972
00:36:31,589 --> 00:36:29,440
what coordination we need i'm suspecting

973
00:36:33,829 --> 00:36:31,599
that it'll be after the fact comparison

974
00:36:36,470 --> 00:36:33,839
of data rather than coordinating the

975
00:36:40,069 --> 00:36:36,480
observations but we've agreed to to look

976
00:36:41,270 --> 00:36:40,079
at that after we both get there

977
00:36:46,710 --> 00:36:41,280
ken

978
00:36:49,030 --> 00:36:46,720
rocket stem magazine i'd like um someone

979
00:36:50,950 --> 00:36:49,040
maybe several of you to talk about why

980
00:36:53,430 --> 00:36:50,960
you chose this particular elliptical

981
00:36:55,430 --> 00:36:53,440
orbit i think the tenuous atmosphere is

982
00:36:58,150 --> 00:36:55,440
extremely more tenuous at the at the

983
00:36:59,829 --> 00:36:58,160
higher 6 000 kilometer altitude so so

984
00:37:02,150 --> 00:36:59,839
why did you pick this orbit why are we

985
00:37:04,710 --> 00:37:02,160
not having an elliptical orbit that's

986
00:37:06,069 --> 00:37:04,720
closer into the planet uh when are these

987
00:37:08,470 --> 00:37:06,079
science instruments making their

988
00:37:11,030 --> 00:37:08,480

measurements is it mostly when we're

989
00:37:12,150 --> 00:37:11,040
at the lower orbit or is it continuous

990
00:37:18,230 --> 00:37:12,160
throughout

991
00:37:21,510 --> 00:37:18,240
and and these guys can chime in as well

992
00:37:23,750 --> 00:37:21,520
we pick the orbit for two reasons one is

993
00:37:26,630 --> 00:37:23,760
with an elliptical orbit that goes

994
00:37:28,470 --> 00:37:26,640
as low as 150 with occasional deep dips

995
00:37:30,550 --> 00:37:28,480
down to 125

996
00:37:32,870 --> 00:37:30,560
we get to sample the entire upper

997
00:37:34,710 --> 00:37:32,880
atmosphere so the in-situ measurements

998
00:37:36,790 --> 00:37:34,720
pass through the important parts of the

999
00:37:39,510 --> 00:37:36,800
atmosphere on every orbit

1000
00:37:41,430 --> 00:37:39,520
at the highest altitudes the iuvs

1001
00:37:43,270 --> 00:37:41,440
instrument can do imaging of the

1002
00:37:45,589 --> 00:37:43,280
emission from the atmosphere to tell us

1003
00:37:48,230 --> 00:37:45,599
about global composition so that

1004
00:37:50,390 --> 00:37:48,240
elliptical orbit with that low altitude

1005
00:37:52,870 --> 00:37:50,400
and high altitude lets us get

1006
00:37:54,870 --> 00:37:52,880
the measurements we need we pick that

1007
00:37:57,349 --> 00:37:54,880
particular orbit as well because the

1008
00:37:59,670 --> 00:37:57,359
gravitational torqueing from the planet

1009
00:38:01,670 --> 00:37:59,680
will cause it to process the plane of

1010
00:38:03,510 --> 00:38:01,680
the orbit will rotate with respect to

1011
00:38:05,670 --> 00:38:03,520
the line from the sun

1012
00:38:08,310 --> 00:38:05,680
and that will let us get different local

1013
00:38:11,349 --> 00:38:08,320

times relative to the sun and it also

1014
00:38:14,069 --> 00:38:11,359
processes in latitude so the latitude of

1015
00:38:17,190 --> 00:38:14,079
of periapsis the closest approach to the

1016
00:38:19,750 --> 00:38:17,200
planet sweeps between plus and minus 75

1017
00:38:21,829 --> 00:38:19,760
degrees so that gives us relatively

1018
00:38:23,349 --> 00:38:21,839
complete coverage in all three

1019
00:38:25,430 --> 00:38:23,359
dimensions

1020
00:38:26,870 --> 00:38:25,440
throughout the orbit we've divided it up

1021
00:38:28,710 --> 00:38:26,880
into segments

1022
00:38:30,790 --> 00:38:28,720
and each instrument makes its

1023
00:38:32,710 --> 00:38:30,800
measurements makes its most important

1024
00:38:34,470 --> 00:38:32,720
measurements at the altitude range that

1025
00:38:37,430 --> 00:38:34,480
is most important to it

1026
00:38:41,510 --> 00:38:37,440
so iuvs and static focus on the high

1027
00:38:44,230 --> 00:38:41,520
altitude parts at the other end

1028
00:38:47,510 --> 00:38:44,240
the engines instrument and static and

1029
00:38:49,270 --> 00:38:47,520
iuvs focus on the low altitude parts

1030
00:38:51,510 --> 00:38:49,280
and everybody takes measurements in the

1031
00:38:53,030 --> 00:38:51,520
middle everybody's taking measurements

1032
00:38:53,829 --> 00:38:53,040
most of the time

1033
00:38:57,750 --> 00:38:53,839
but

1034
00:38:59,109 --> 00:38:57,760
different altitudes provide different

1035
00:39:00,630 --> 00:38:59,119
different measurements that tell us

1036
00:39:01,910 --> 00:39:00,640
about different aspects of the upper

1037
00:39:03,829 --> 00:39:01,920
atmosphere

1038
00:39:05,750 --> 00:39:03,839

nick or paul in particular do you want

1039
00:39:08,069 --> 00:39:05,760
to add to that um i do want to add to

1040
00:39:10,390 --> 00:39:08,079
this and bruce referred to how at great

1041
00:39:12,870 --> 00:39:10,400
distances our instrument is able to make

1042
00:39:15,829 --> 00:39:12,880
images of the planet and the atmospheric

1043
00:39:18,150 --> 00:39:15,839
ingredients but it's uh just as

1044
00:39:20,470 --> 00:39:18,160
important and the times when we're

1045
00:39:22,710 --> 00:39:20,480
rising up above the planet we look

1046
00:39:24,630 --> 00:39:22,720
sideways through the uppermost layers of

1047
00:39:26,710 --> 00:39:24,640
the atmosphere and when i say uppermost

1048
00:39:29,670 --> 00:39:26,720
i mean thousands of kilometers in

1049
00:39:32,630 --> 00:39:29,680
altitude so we are still detecting

1050
00:39:35,270 --> 00:39:32,640
hydrogen and oxygen uh thousands of

1051
00:39:37,270 --> 00:39:35,280
kilometers above the surface those being

1052
00:39:39,349 --> 00:39:37,280
the ingredients of broken down water

1053
00:39:42,230 --> 00:39:39,359
this is really an essential part of

1054
00:39:43,829 --> 00:39:42,240
solving the problem

1055
00:39:45,670 --> 00:39:43,839
excuse me and of course the atmosphere

1056
00:39:47,750 --> 00:39:45,680
gets denser and denser as you go down

1057
00:39:49,990 --> 00:39:47,760
toward the well-mixed atmosphere

1058
00:39:52,310 --> 00:39:50,000
uh interesting to note that we really

1059
00:39:55,030 --> 00:39:52,320
don't have a lot of information in the

1060
00:39:57,270 --> 00:39:55,040
in the deep atmosphere uh some of the

1061
00:39:59,510 --> 00:39:57,280
current orbiters are focused primarily

1062
00:40:01,589 --> 00:39:59,520
on uh remote sensing and spectroscopy

1063
00:40:03,990 --> 00:40:01,599

and so on and we have a couple of

1064
00:40:05,670 --> 00:40:04,000
measurements way back from viking and

1065
00:40:07,910 --> 00:40:05,680
you know they're kind of one point

1066
00:40:09,990 --> 00:40:07,920
measurements as the aeroshell went down

1067
00:40:11,510 --> 00:40:10,000
into the atmosphere supporting the

1068
00:40:13,430 --> 00:40:11,520
landers there was some really

1069
00:40:15,109 --> 00:40:13,440
interesting data obtained but we're

1070
00:40:16,870 --> 00:40:15,119
really just going to get hundreds of

1071
00:40:18,470 --> 00:40:16,880
these measurements over the course of

1072
00:40:20,630 --> 00:40:18,480
the primary missions so

1073
00:40:21,990 --> 00:40:20,640
the orbit allows us to do that it allows

1074
00:40:25,910 --> 00:40:22,000
us to

1075
00:40:28,150 --> 00:40:25,920
look at different local times and

1076
00:40:30,470 --> 00:40:28,160
day night variations and then of course

1077
00:40:33,030 --> 00:40:30,480
with the many many orbits look at

1078
00:40:34,390 --> 00:40:33,040
how the atmosphere is changing both with

1079
00:40:35,829 --> 00:40:34,400
things that are happening on the surface

1080
00:40:37,910 --> 00:40:35,839
like dust storms the atmosphere is

1081
00:40:40,309 --> 00:40:37,920
breathing in and out and as a solar

1082
00:40:42,550 --> 00:40:40,319
input to the atmosphere is changing so

1083
00:40:44,150 --> 00:40:42,560
that orbit really enables this this

1084
00:40:45,589 --> 00:40:44,160
repetitive look at the atmosphere that

1085
00:40:47,910 --> 00:40:45,599
you need to study some of these

1086
00:40:49,829 --> 00:40:47,920
processes i need to clarify part of my

1087
00:40:51,510 --> 00:40:49,839
answer i talked about the atmosphere

1088
00:40:53,109 --> 00:40:51,520

going up thousands of kilometers the

1089
00:40:55,829 --> 00:40:53,119
technical term that we use is the

1090
00:40:58,470 --> 00:40:55,839
exosphere because it's really really

1091
00:41:00,150 --> 00:40:58,480
thin so thin that actually the

1092
00:41:01,670 --> 00:41:00,160
atoms don't collide with each other

1093
00:41:04,230 --> 00:41:01,680
nonetheless our instruments have the

1094
00:41:06,390 --> 00:41:04,240
sensitivity that we can actually

1095
00:41:08,309 --> 00:41:06,400
measure that very rarefied gas

1096
00:41:09,990 --> 00:41:08,319
i could add to the answer as well

1097
00:41:11,750 --> 00:41:10,000
the particles in field suite is making

1098
00:41:13,190 --> 00:41:11,760
measurements throughout the orbit it's

1099
00:41:15,510 --> 00:41:13,200
important to realize that we want to

1100
00:41:17,349 --> 00:41:15,520
understand the sun as a driver so as the

1101
00:41:19,349 --> 00:41:17,359
solar wind changes

1102
00:41:21,829 --> 00:41:19,359
the velocity increases that the density

1103
00:41:23,990 --> 00:41:21,839
increases how does the planet respond

1104
00:41:25,270 --> 00:41:24,000
and so when we see things happening in

1105
00:41:26,790 --> 00:41:25,280
the solar wind we're going to definitely

1106
00:41:28,870 --> 00:41:26,800
try to make correlations with how the

1107
00:41:30,710 --> 00:41:28,880
planet responds so it's really important

1108
00:41:32,390 --> 00:41:30,720
to make these high altitude measurements

1109
00:41:35,829 --> 00:41:32,400
to make those connections and so it's an

1110
00:41:37,270 --> 00:41:35,839
important part of the maven strategy

1111
00:41:38,630 --> 00:41:37,280
we're going to stop and take a question

1112
00:41:39,430 --> 00:41:38,640
on the phone and then we'll come back

1113
00:41:42,470 --> 00:41:39,440

here

1114
00:41:44,710 --> 00:41:42,480
irene klotz from reuters

1115
00:41:47,270 --> 00:41:44,720
oh thanks very much george um

1116
00:41:49,750 --> 00:41:47,280
this question is for uh for bruce i

1117
00:41:51,589 --> 00:41:49,760
think last month you said that the uh

1118
00:41:55,030 --> 00:41:51,599
there'd be enough fuel aboard the

1119
00:41:57,670 --> 00:41:55,040
spacecraft for uh ten years um primarily

1120
00:42:00,230 --> 00:41:57,680
to serve as a communications relay after

1121
00:42:01,510 --> 00:42:00,240
the first year of science operations and

1122
00:42:05,510 --> 00:42:01,520
i was wondering

1123
00:42:08,150 --> 00:42:05,520
if um the orbit would be circularized to

1124
00:42:09,910 --> 00:42:08,160
serve that communications relay function

1125
00:42:11,829 --> 00:42:09,920
and if so

1126
00:42:13,829 --> 00:42:11,839
how does that impact any additional

1127
00:42:15,829 --> 00:42:13,839
science from a follow-on mission or how

1128
00:42:18,309 --> 00:42:15,839
are you going to kind of balance off the

1129
00:42:20,150 --> 00:42:18,319
desire for additional science with the

1130
00:42:22,069 --> 00:42:20,160
secondary role as a

1131
00:42:24,710 --> 00:42:22,079
calm relay thanks

1132
00:42:27,190 --> 00:42:24,720
well let me first clarify that

1133
00:42:29,190 --> 00:42:27,200
we designed the spacecraft and the

1134
00:42:31,589 --> 00:42:29,200
amount of fuel we carry to be sure we

1135
00:42:34,470 --> 00:42:31,599
can accomplish our primary mission

1136
00:42:36,390 --> 00:42:34,480
so the the amount of fuel was sized so

1137
00:42:39,030 --> 00:42:36,400
that if we have problems getting into

1138
00:42:41,510 --> 00:42:39,040

orbit we can recover from that we don't

1139
00:42:43,990 --> 00:42:41,520
anticipate that in which case the extra

1140
00:42:47,829 --> 00:42:44,000
fuel we carry would be able to use to be

1141
00:42:53,430 --> 00:42:47,839
used to extend our operations in orbit

1142
00:42:57,270 --> 00:42:56,309
continue to operate for as long as 10

1143
00:42:59,030 --> 00:42:57,280
years

1144
00:43:02,870 --> 00:42:59,040
of course that remains to be seen we'll

1145
00:43:04,150 --> 00:43:02,880
find out as we go through the process

1146
00:43:07,750 --> 00:43:04,160
the

1147
00:43:08,870 --> 00:43:07,760
first year primary mission

1148
00:43:11,270 --> 00:43:08,880
we've set

1149
00:43:14,230 --> 00:43:11,280
up what we're going to do we have enough

1150
00:43:16,630 --> 00:43:14,240
fuel to continue making observations in

1151
00:43:19,750 --> 00:43:16,640
the same mode if we don't need to

1152
00:43:20,950 --> 00:43:19,760
correct our orbit after we go into

1153
00:43:23,109 --> 00:43:20,960
into orbit

1154
00:43:24,069 --> 00:43:23,119
we can continue observations in the same

1155
00:43:27,430 --> 00:43:24,079
mode

1156
00:43:29,510 --> 00:43:27,440
for about two two more years then what

1157
00:43:32,150 --> 00:43:29,520
we would have to do is raise our

1158
00:43:34,550 --> 00:43:32,160
periapsis so that atmospheric drag

1159
00:43:36,870 --> 00:43:34,560
becomes less of a factor we wouldn't

1160
00:43:39,109 --> 00:43:36,880
circularize our orbit but we'd get the

1161
00:43:41,030 --> 00:43:39,119
lowest part out of a little bit further

1162
00:43:43,109 --> 00:43:41,040
out of the upper atmosphere to conserve

1163
00:43:45,750 --> 00:43:43,119

fuel and at that point we'd be able to

1164
00:43:47,670 --> 00:43:45,760
continue a combination of

1165
00:43:50,150 --> 00:43:47,680
science observations and relay

1166
00:43:51,190 --> 00:43:50,160
operations perhaps out to the 10-year

1167
00:43:53,270 --> 00:43:51,200
mark

1168
00:43:55,510 --> 00:43:53,280
i believe that that

1169
00:43:57,829 --> 00:43:55,520
relay and science can co-exist and we

1170
00:44:00,309 --> 00:43:57,839
ought to be able to do both of those uh

1171
00:44:01,510 --> 00:44:00,319
after the primary mission until uh

1172
00:44:03,750 --> 00:44:01,520
through the whole lifetime of the

1173
00:44:05,510 --> 00:44:03,760
spacecraft

1174
00:44:08,390 --> 00:44:05,520
right here

1175
00:44:10,230 --> 00:44:08,400
maybe a quick follow-up then for mike is

1176
00:44:14,309 --> 00:44:10,240
um

1177
00:44:17,510 --> 00:44:14,319
with both uh and global survey are

1178
00:44:22,390 --> 00:44:17,520
getting on in years what's the plan for

1179
00:44:25,670 --> 00:44:22,400
calm relay for inside and mars 2020 um

1180
00:44:27,030 --> 00:44:25,680
if maven's not taking on that dedicated

1181
00:44:29,510 --> 00:44:27,040
role

1182
00:44:32,230 --> 00:44:29,520
yeah as you correctly point out uh the

1183
00:44:35,430 --> 00:44:32,240
two main communication orbiters we have

1184
00:44:38,309 --> 00:44:35,440
right now that are doing science uh are

1185
00:44:40,069 --> 00:44:38,319
odyssey and mars reconnaissance orbiter

1186
00:44:42,309 --> 00:44:40,079
and they are getting long in the tooth

1187
00:44:43,270 --> 00:44:42,319
and we do have to plan for

1188
00:44:44,710 --> 00:44:43,280

um

1189
00:44:47,829 --> 00:44:44,720
eventually when they're no longer

1190
00:44:49,349 --> 00:44:47,839
operational so this is a concern and for

1191
00:44:52,150 --> 00:44:49,359
this reason

1192
00:44:53,829 --> 00:44:52,160
every spacecraft that we send to the red

1193
00:44:56,390 --> 00:44:53,839
planet and

1194
00:44:58,710 --> 00:44:56,400
even other nations who send a spacecraft

1195
00:45:00,710 --> 00:44:58,720
to the planet we ask them to carry a

1196
00:45:04,950 --> 00:45:00,720
communication advice so that there is

1197
00:45:06,950 --> 00:45:04,960
the opportunity to communicate with

1198
00:45:08,470 --> 00:45:06,960
on the surface assets

1199
00:45:10,550 --> 00:45:08,480
through the orbiters

1200
00:45:11,430 --> 00:45:10,560
so the plan is

1201
00:45:13,270 --> 00:45:11,440
we've

1202
00:45:14,870 --> 00:45:13,280
the analysis have been done on what the

1203
00:45:16,630 --> 00:45:14,880
expected lifetime is and what the

1204
00:45:19,030 --> 00:45:16,640
probability of having one or two

1205
00:45:21,349 --> 00:45:19,040
orbiters by the time we have insight

1206
00:45:22,950 --> 00:45:21,359
land on mars and then also when we send

1207
00:45:26,870 --> 00:45:22,960
the 2020 rover

1208
00:45:30,470 --> 00:45:26,880
and we're okay and we're using basically

1209
00:45:32,150 --> 00:45:30,480
maven will be a backup mars express may

1210
00:45:34,150 --> 00:45:32,160
still be going and mars express has the

1211
00:45:35,990 --> 00:45:34,160
capability of doing

1212
00:45:37,430 --> 00:45:36,000
uh communications with

1213
00:45:38,710 --> 00:45:37,440

the rovers

1214
00:45:39,510 --> 00:45:38,720
and so

1215
00:45:42,790 --> 00:45:39,520
we're

1216
00:45:45,349 --> 00:45:42,800
recognizing that our spacecraft are

1217
00:45:48,550 --> 00:45:45,359
getting older and but we're having

1218
00:45:51,030 --> 00:45:48,560
backups so that uh if need be uh we can

1219
00:45:53,589 --> 00:45:51,040
call on them to provide communications

1220
00:45:58,950 --> 00:45:56,710
cbcn university of montreal i'd like to

1221
00:46:01,349 --> 00:45:58,960
know if the models of the evolution of

1222
00:46:04,550 --> 00:46:01,359
the sun are constrained well enough to

1223
00:46:08,150 --> 00:46:04,560
allow us to study its the past impact of

1224
00:46:10,630 --> 00:46:08,160
the sun on mars atmosphere

1225
00:46:12,790 --> 00:46:10,640
that's a very good question the history

1226
00:46:16,069 --> 00:46:12,800
of the sun is one of the major

1227
00:46:19,750 --> 00:46:16,079
outstanding problems of solar system

1228
00:46:20,630 --> 00:46:19,760
exploration in the evolutionary area

1229
00:46:21,349 --> 00:46:20,640
and

1230
00:46:26,550 --> 00:46:21,359
the

1231
00:46:28,950 --> 00:46:26,560
fortunately getting better and better

1232
00:46:31,109 --> 00:46:28,960
and so people can appreciate that sun

1233
00:46:33,430 --> 00:46:31,119
like stars have cycles

1234
00:46:36,150 --> 00:46:33,440
and there's a pretty well established

1235
00:46:37,829 --> 00:46:36,160
trend of the extreme ultraviolet flux

1236
00:46:39,510 --> 00:46:37,839
with time

1237
00:46:42,470 --> 00:46:39,520
they can tell how

1238
00:46:43,990 --> 00:46:42,480

old a sun-like star is by its rotation

1239
00:46:48,150 --> 00:46:44,000
rate

1240
00:46:50,870 --> 00:46:48,160
and so uh the astrophysics community and

1241
00:46:52,870 --> 00:46:50,880
and astronomy community have uh have

1242
00:46:55,109 --> 00:46:52,880
been focusing part of that community has

1243
00:46:57,589 --> 00:46:55,119
been focusing on sun-like stars and

1244
00:47:00,470 --> 00:46:57,599
their evolution uh an outstanding

1245
00:47:01,750 --> 00:47:00,480
question remains uh the nature of their

1246
00:47:07,109 --> 00:47:01,760
activity

1247
00:47:09,910 --> 00:47:07,119
implied by their higher extreme

1248
00:47:11,829 --> 00:47:09,920
ultraviolet fluxes uh at an early age

1249
00:47:14,069 --> 00:47:11,839
also implies a lot more coronal mass

1250
00:47:15,109 --> 00:47:14,079
ejections and solar energetic particles

1251
00:47:17,109 --> 00:47:15,119
and

1252
00:47:20,230 --> 00:47:17,119
stronger solar wind gusts

1253
00:47:22,309 --> 00:47:20,240
so we hope to uh to be doing our science

1254
00:47:23,430 --> 00:47:22,319
in parallel with the astrophysics

1255
00:47:25,910 --> 00:47:23,440
community

1256
00:47:29,270 --> 00:47:25,920
and as that that further

1257
00:47:31,510 --> 00:47:29,280
is further constrained by that research

1258
00:47:33,589 --> 00:47:31,520
we will combine the two banks of

1259
00:47:36,470 --> 00:47:33,599
knowledge and a best guess

1260
00:47:39,750 --> 00:47:36,480
of the outcome

1261
00:47:41,109 --> 00:47:39,760
right here hi uh jeff foust of space

1262
00:47:42,710 --> 00:47:41,119
review for bruce or anyone else on the

1263
00:47:44,470 --> 00:47:42,720

science team you've been working on this

1264
00:47:46,150 --> 00:47:44,480
project now for several years is the day

1265
00:47:48,309 --> 00:47:46,160
before launch how do you feel right now

1266
00:47:49,750 --> 00:47:48,319
excited nervous something else all of

1267
00:47:51,829 --> 00:47:49,760
the above

1268
00:47:53,109 --> 00:47:51,839
uh that several years is actually 10

1269
00:47:55,670 --> 00:47:53,119
years

1270
00:47:57,829 --> 00:47:55,680
since we started the putting together

1271
00:48:01,030 --> 00:47:57,839
the original concept

1272
00:48:05,190 --> 00:48:02,790
it really is all of the above i don't

1273
00:48:07,190 --> 00:48:05,200
know how to put into words

1274
00:48:08,549 --> 00:48:07,200
what it feels like to be down to the day

1275
00:48:10,230 --> 00:48:08,559
before launch

1276
00:48:12,309 --> 00:48:10,240
but i'll tell you it was one of the the

1277
00:48:14,230 --> 00:48:12,319
most exciting things i've done to go out

1278
00:48:15,109 --> 00:48:14,240
yesterday and watch the roll out to the

1279
00:48:17,829 --> 00:48:15,119
pad

1280
00:48:21,349 --> 00:48:17,839
and see the the rocket and the

1281
00:48:23,349 --> 00:48:21,359
spacecraft inside it come out of the

1282
00:48:26,069 --> 00:48:23,359
integration facility that it had been

1283
00:48:29,349 --> 00:48:26,079
stacked in and to see the maven logo on

1284
00:48:33,430 --> 00:48:31,270
i just don't have the words for it but

1285
00:48:35,829 --> 00:48:33,440
it's an incredible experience

1286
00:48:39,270 --> 00:48:35,839
and i recommend everybody should be a pi

1287
00:48:43,430 --> 00:48:41,030
if i could add another perspective on

1288
00:48:45,589 --> 00:48:43,440

this missions like this usually start on

1289
00:48:46,870 --> 00:48:45,599
the back of a napkin

1290
00:48:50,150 --> 00:48:46,880
and then they go to the back of the

1291
00:48:52,309 --> 00:48:50,160
envelope and onto a whiteboard

1292
00:48:54,870 --> 00:48:52,319
and powerpoint and before you know it

1293
00:48:56,549 --> 00:48:54,880
it's in the computer-aided design

1294
00:48:58,470 --> 00:48:56,559
drawings and it's got aluminum

1295
00:49:00,230 --> 00:48:58,480
prototypes and then they're wiring it up

1296
00:49:02,870 --> 00:49:00,240
and then they're shipping it and here it

1297
00:49:05,030 --> 00:49:02,880
is on the launchpad and in a lot of ways

1298
00:49:07,589 --> 00:49:05,040
it's gone much faster than i thought

1299
00:49:09,589 --> 00:49:07,599
because there's this this drum beat of

1300
00:49:11,109 --> 00:49:09,599
the progress that's necessary to get

1301
00:49:13,430 --> 00:49:11,119
ready for launch

1302
00:49:16,630 --> 00:49:13,440
so it's been a great ride

1303
00:49:18,549 --> 00:49:16,640
i've received a center received 27 000

1304
00:49:20,870 --> 00:49:18,559
maven emails

1305
00:49:24,549 --> 00:49:20,880
and that sounds like a small fraction of

1306
00:49:29,990 --> 00:49:27,670
right uh james

1307
00:49:31,670 --> 00:49:30,000
uh hi i'm sorry james dean right next to

1308
00:49:34,549 --> 00:49:31,680
you there i'm sorry

1309
00:49:36,390 --> 00:49:34,559
um james in florida today uh in terms of

1310
00:49:37,270 --> 00:49:36,400
habit habitability i'm just wondering if

1311
00:49:39,430 --> 00:49:37,280
you could

1312
00:49:40,470 --> 00:49:39,440
discuss a little more how will your

1313
00:49:42,790 --> 00:49:40,480

findings

1314
00:49:44,390 --> 00:49:42,800
is it about telling you more about

1315
00:49:47,349 --> 00:49:44,400
what the atmosphere that used to be

1316
00:49:49,589 --> 00:49:47,359
there was like or is it more about

1317
00:49:51,750 --> 00:49:49,599
perhaps just like framing the period

1318
00:49:53,030 --> 00:49:51,760
during which the most habitable

1319
00:49:54,150 --> 00:49:53,040
conditions would have been or is it

1320
00:49:56,950 --> 00:49:54,160
something else

1321
00:49:58,870 --> 00:49:56,960
i see this mission as at its core in

1322
00:50:00,069 --> 00:49:58,880
astrobiology mission

1323
00:50:02,790 --> 00:50:00,079
because

1324
00:50:05,109 --> 00:50:02,800
one of the real intellectual drivers for

1325
00:50:07,349 --> 00:50:05,119
mars is understanding whether there was

1326
00:50:10,309 --> 00:50:07,359
life or could have been life

1327
00:50:11,829 --> 00:50:10,319
and with the climate why do we appear to

1328
00:50:19,190 --> 00:50:11,839
have

1329
00:50:20,950 --> 00:50:19,200
on and we don't today you know something

1330
00:50:24,309 --> 00:50:20,960
fundamentally changed and we want to

1331
00:50:26,630 --> 00:50:24,319
understand what those changes were so

1332
00:50:28,470 --> 00:50:26,640
i i really do see this as a mission

1333
00:50:30,950 --> 00:50:28,480
about the history of martian

1334
00:50:32,390 --> 00:50:30,960
habitability and of course habitability

1335
00:50:34,390 --> 00:50:32,400
by microbes

1336
00:50:37,430 --> 00:50:34,400
if we think more broadly

1337
00:50:40,549 --> 00:50:37,440
we're understanding processes by which

1338
00:50:42,309 --> 00:50:40,559

a planetary environment can change

1339
00:50:44,470 --> 00:50:42,319
through time we don't know the whole

1340
00:50:46,309 --> 00:50:44,480
range of processes yet but as we're

1341
00:50:48,710 --> 00:50:46,319
starting to discover more and more

1342
00:50:51,190 --> 00:50:48,720
planets outside our solar system and see

1343
00:50:53,510 --> 00:50:51,200
earth-like planets and ask about whether

1344
00:50:55,990 --> 00:50:53,520
there could be life on those we want to

1345
00:50:57,750 --> 00:50:56,000
understand what makes a planet habitable

1346
00:51:00,150 --> 00:50:57,760
and what makes a planet go from being

1347
00:51:02,390 --> 00:51:00,160
habitable to not being habitable so i

1348
00:51:04,710 --> 00:51:02,400
see this as as a much broader mission

1349
00:51:06,390 --> 00:51:04,720
than just exploring the mars upper

1350
00:51:08,309 --> 00:51:06,400
atmosphere today and learning about the

1351
00:51:10,069 --> 00:51:08,319
history of the climate but that's where

1352
00:51:13,109 --> 00:51:10,079
we start because those are the questions

1353
00:51:16,309 --> 00:51:13,119
that we get the first answer to

1354
00:51:19,750 --> 00:51:16,319
right here thank you tony rice wral tv

1355
00:51:21,990 --> 00:51:19,760
and social media mars wx report had a

1356
00:51:23,990 --> 00:51:22,000
question about public engagement i was

1357
00:51:25,910 --> 00:51:24,000
curious what the plans were for data

1358
00:51:27,750 --> 00:51:25,920
availability would there be an embargo

1359
00:51:29,910 --> 00:51:27,760
would it go into the

1360
00:51:32,309 --> 00:51:29,920
planetary data system as it normally

1361
00:51:35,030 --> 00:51:32,319
does and would there be any

1362
00:51:36,870 --> 00:51:35,040
plans to engage the public with the

1363
00:51:38,230 --> 00:51:36,880

meteorologic data that you're you're

1364
00:51:40,230 --> 00:51:38,240
producing here similar to the way the

1365
00:51:42,630 --> 00:51:40,240
curiosity rover has produced

1366
00:51:44,870 --> 00:51:42,640
meteorologic data on a daily basis

1367
00:51:47,510 --> 00:51:44,880
we will be making data available to the

1368
00:51:48,710 --> 00:51:47,520
public both the public at large and the

1369
00:51:55,430 --> 00:51:48,720
the

1370
00:51:57,510 --> 00:51:55,440
uh our plan is to make it available as

1371
00:51:59,190 --> 00:51:57,520
soon as possible

1372
00:52:02,470 --> 00:51:59,200
as you've heard described here though

1373
00:52:04,470 --> 00:52:02,480
the the data is not instantly easy to

1374
00:52:05,589 --> 00:52:04,480
interpret it comes in a form

1375
00:52:11,910 --> 00:52:05,599
that

1376
00:52:13,670 --> 00:52:11,920
going to need to take time to make sure

1377
00:52:16,069 --> 00:52:13,680
they understand how the instruments are

1378
00:52:17,670 --> 00:52:16,079
operating what the calibration is and

1379
00:52:20,470 --> 00:52:17,680
that we've applied the calibration the

1380
00:52:22,870 --> 00:52:20,480
last thing we want to do is put out data

1381
00:52:24,390 --> 00:52:22,880
that is hard to interpret or has to be

1382
00:52:27,510 --> 00:52:24,400
corrected later when we better

1383
00:52:28,790 --> 00:52:27,520
understand the calibration

1384
00:52:30,950 --> 00:52:28,800
by by

1385
00:52:33,190 --> 00:52:30,960
decree from nasa headquarters there is

1386
00:52:35,510 --> 00:52:33,200
no proprietary period

1387
00:52:37,990 --> 00:52:35,520
and we are obligated to put the data

1388
00:52:39,990 --> 00:52:38,000

into the planetary data system as soon

1389
00:52:42,710 --> 00:52:40,000
as it's available and we have a schedule

1390
00:52:45,430 --> 00:52:42,720
set up by which we will do that

1391
00:52:46,549 --> 00:52:45,440
so we're absolutely committed to making

1392
00:52:49,109 --> 00:52:46,559
it available

1393
00:52:51,109 --> 00:52:49,119
my goal is to make the data as available

1394
00:52:53,270 --> 00:52:51,119
to everybody as possible because then we

1395
00:52:54,549 --> 00:52:53,280
can really get a lot of people doing

1396
00:52:56,150 --> 00:52:54,559
science with it

1397
00:52:57,829 --> 00:52:56,160
did you want to mention the other epo

1398
00:53:00,309 --> 00:52:57,839
activities

1399
00:53:03,030 --> 00:53:00,319
on the mission go ahead okay so of

1400
00:53:04,549 --> 00:53:03,040
course uh we're also spending a fraction

1401
00:53:07,349 --> 00:53:04,559
of the maven budget on educational

1402
00:53:10,069 --> 00:53:07,359
activities things like teacher workshops

1403
00:53:11,829 --> 00:53:10,079
uh there's a great show to be projected

1404
00:53:14,630 --> 00:53:11,839
on the science on a sphere displays we

1405
00:53:16,549 --> 00:53:14,640
expect to go national a lot of attention

1406
00:53:18,069 --> 00:53:16,559
to serving underrepresented communities

1407
00:53:19,829 --> 00:53:18,079
in science

1408
00:53:22,950 --> 00:53:19,839
okay question right here

1409
00:53:24,309 --> 00:53:22,960
hi dawn hello for cbc question for janet

1410
00:53:26,950 --> 00:53:24,319
one of your graphics you showed these

1411
00:53:29,109 --> 00:53:26,960
isolated magnetic bubbles did mars once

1412
00:53:31,750 --> 00:53:29,119
then have a more extensive global

1413
00:53:34,309 --> 00:53:31,760

magnetic field and when did it break

1414
00:53:35,750 --> 00:53:34,319
down maybe allowing more atmosphere to

1415
00:53:38,230 --> 00:53:35,760
be stripped away

1416
00:53:40,630 --> 00:53:38,240
yes the mars global surveyor mission

1417
00:53:43,349 --> 00:53:40,640
first measured those crustal magnetic

1418
00:53:45,829 --> 00:53:43,359
fields and the

1419
00:53:47,270 --> 00:53:45,839
crater record and

1420
00:53:49,670 --> 00:53:47,280
others

1421
00:53:51,670 --> 00:53:49,680
knowledge of the way magnetic fields and

1422
00:53:53,829 --> 00:53:51,680
dynamos work has

1423
00:53:56,390 --> 00:53:53,839
led the community to

1424
00:53:59,190 --> 00:53:56,400
conclude that there was probably

1425
00:54:01,510 --> 00:53:59,200
an early global dynamo of mars with a

1426
00:54:03,109 --> 00:54:01,520
stronger dipole field

1427
00:54:04,470 --> 00:54:03,119
and

1428
00:54:07,349 --> 00:54:04,480
the dating

1429
00:54:09,190 --> 00:54:07,359
suggests that it disappeared around the

1430
00:54:11,750 --> 00:54:09,200
time of

1431
00:54:14,870 --> 00:54:11,760
the atmosphere's disappearance at about

1432
00:54:15,910 --> 00:54:14,880
three and a half billion years of age

1433
00:54:17,750 --> 00:54:15,920
um

1434
00:54:21,430 --> 00:54:17,760
or ago

1435
00:54:22,950 --> 00:54:21,440
so that we are examining the processes

1436
00:54:24,950 --> 00:54:22,960
that started

1437
00:54:27,430 --> 00:54:24,960
at about

1438
00:54:28,230 --> 00:54:27,440

mars being a billion years of age after

1439
00:54:29,910 --> 00:54:28,240
the

1440
00:54:31,910 --> 00:54:29,920
initial period of

1441
00:54:34,390 --> 00:54:31,920
internal dynamo activity and strong

1442
00:54:36,309 --> 00:54:34,400
magnetic field presence

1443
00:54:38,069 --> 00:54:36,319
okay we'll take one final question from

1444
00:54:39,109 --> 00:54:38,079
bill harwood and that will wrap us up

1445
00:54:41,190 --> 00:54:39,119
simple question i'm sure it's in the

1446
00:54:43,349 --> 00:54:41,200
press kit but how does the what is the

1447
00:54:44,549 --> 00:54:43,359
data that comes back is it what part of

1448
00:54:46,789 --> 00:54:44,559
the arbitrage are you doing that is it

1449
00:54:49,589 --> 00:54:46,799
continuous how does it get back

1450
00:54:51,349 --> 00:54:49,599
we we are collecting the data on board

1451
00:54:53,910 --> 00:54:51,359
and storing it on board we'll send it

1452
00:54:55,589 --> 00:54:53,920
back uh twice once we're in orbit once

1453
00:54:57,990 --> 00:54:55,599
in our in our science mapping orbit

1454
00:55:00,069 --> 00:54:58,000
we'll send it back twice per week

1455
00:55:01,750 --> 00:55:00,079
you will have seen on the the model of

1456
00:55:04,710 --> 00:55:01,760
the spacecraft that the high gain

1457
00:55:07,510 --> 00:55:04,720
antenna is body mounted it's fixed that

1458
00:55:09,670 --> 00:55:07,520
means if we want to point at the earth

1459
00:55:11,910 --> 00:55:09,680
we have to point the whole spacecraft

1460
00:55:14,150 --> 00:55:11,920
and that means we aren't making our

1461
00:55:16,069 --> 00:55:14,160
complete set of measurements

1462
00:55:18,150 --> 00:55:16,079
uh while we're sending data back to the

1463
00:55:21,510 --> 00:55:18,160

earth so there's a trade-off between how

1464
00:55:23,190 --> 00:55:21,520
often we want to do that and take away

1465
00:55:25,670 --> 00:55:23,200
from the science measurements versus how

1466
00:55:29,510 --> 00:55:25,680
much data we can send back we've settled

1467
00:55:33,750 --> 00:55:30,950
all right that event that's going to

1468
00:55:37,589 --> 00:55:33,760
wrap things up just a couple of notes

1469
00:55:39,510 --> 00:55:37,599
the website is www.nasa.gov

1470
00:55:42,150 --> 00:55:39,520
backslash maven

1471
00:55:44,870 --> 00:55:42,160
our launch coverage on nasa tv on monday

1472
00:55:48,789 --> 00:55:44,880
morning begins at 11 a.m that coincides

1473
00:55:50,870 --> 00:55:48,799
with the start of fueling of the atlas v

1474
00:55:52,630 --> 00:55:50,880
and now we're going to show you to

1475
00:55:55,270 --> 00:55:52,640
conclude our activity this morning our

1476
00:55:58,150 --> 00:55:55,280
briefing is an animation of the

1477
00:56:00,789 --> 00:55:58,160
evolution of mars as a wet planet and

1478
00:56:03,030 --> 00:56:00,799
into a dry planet that explains somewhat