1
00:00:08,310 --> 00:00:07,030
good afternoon everyone this is our

2
00:00:09,830 --> 00:00:08,320
briefing on

3
00:00:11,190 --> 00:00:09,840
looking for signs of life in the

4
00:00:13,509 --> 00:00:11,200
universe

5
00:00:16,029 --> 00:00:13,519
and here to discuss that topic

6
00:00:18,070 --> 00:00:16,039
is mary voitak the director of the

7
00:00:21,830 --> 00:00:18,080
astrobiology program

8
00:00:24,230 --> 00:00:21,840
at nasa headquarters in washington

9
00:00:26,870 --> 00:00:24,240
pam conrad the deputy principal

10
00:00:28,950 --> 00:00:26,880
investigator for the sample analysis at

11
00:00:30,870 --> 00:00:28,960
mars on the mars science laboratory

12
00:00:34,549 --> 00:00:30,880
mission from nasa's goddard space flight

13
00:00:37,510 --> 00:00:36,150

jamie foster

14
00:00:39,990 --> 00:00:37,520
professor for the department of

15
00:00:44,310 --> 00:00:40,000
microbiology and cell science at the

16
00:00:45,750 --> 00:00:44,320
university of florida in gainesville

17
00:00:47,830 --> 00:00:45,760
steve brenner

18
00:00:49,590 --> 00:00:47,840
director for the foundation of applied

19
00:00:55,350 --> 00:00:49,600
molecular evolution

20
00:00:59,750 --> 00:00:57,910
and catherine conley i'm sorry uh

21
00:01:01,270 --> 00:00:59,760
stephen benner director for the

22
00:01:03,110 --> 00:01:01,280
foundation for applied molecular

23
00:01:05,270 --> 00:01:03,120
evolution we've got steve and then the

24
00:01:06,789 --> 00:01:05,280
catherine connelly planetary protection

25
00:01:09,109 --> 00:01:06,799
officer from nasa headquarters in

26
00:01:10,469 --> 00:01:09,119
washington so we'll begin first with

27
00:01:12,390 --> 00:01:10,479
mary wojtek

28
00:01:13,990 --> 00:01:12,400
thank you george

29
00:01:17,190 --> 00:01:14,000
so i'm mary wojtek i'm the head of the

30
00:01:19,510 --> 00:01:17,200
astrobiology program and when discussing

31
00:01:21,830 --> 00:01:19,520
looking for signs of life we need to

32
00:01:24,310 --> 00:01:21,840
talk about a program at nasa that's

33
00:01:27,670 --> 00:01:24,320
invested over 40 years in research and

34
00:01:29,429 --> 00:01:27,680
analysis programs to understand some

35
00:01:31,749 --> 00:01:29,439
fundamental questions

36
00:01:33,510 --> 00:01:31,759
as we try to approach looking at the

37
00:01:35,190 --> 00:01:33,520
distribution of life in the universe and

38
00:01:36,870 --> 00:01:35,200

if i could please please have the first

39
00:01:39,910 --> 00:01:36,880
slide

40
00:01:42,069 --> 00:01:39,920
so this is an artist's rendition of what

41
00:01:44,710 --> 00:01:42,079
that program encompasses from prebiotic

42
00:01:46,069 --> 00:01:44,720
chemistry to understanding how life

43
00:01:48,469 --> 00:01:46,079
originated

44
00:01:50,310 --> 00:01:48,479
to how it evolved and how it persists on

45
00:01:52,950 --> 00:01:50,320
earth and what's the possibility of

46
00:01:55,830 --> 00:01:52,960
finding it elsewhere and it basically

47
00:01:57,429 --> 00:01:55,840
answers three fundamental questions

48
00:01:59,670 --> 00:01:57,439
where have we come from that's the

49
00:02:01,910 --> 00:01:59,680
origin evolution where are we going

50
00:02:04,389 --> 00:02:01,920
that's our future on this planet and are

51
00:02:06,149 --> 00:02:04,399
we alone in in the universe so is there

52
00:02:08,469 --> 00:02:06,159
life elsewhere

53
00:02:11,190 --> 00:02:08,479
now i mentioned that we've been at this

54
00:02:12,229 --> 00:02:11,200
for over 40 years the exobiology program

55
00:02:15,270 --> 00:02:12,239
which was the precursor to the

56
00:02:18,309 --> 00:02:15,280
astrobiology program started in the 60s

57
00:02:20,710 --> 00:02:18,319
with research and analysis that provided

58
00:02:22,790 --> 00:02:20,720
the conceptions and rationale for over

59
00:02:25,270 --> 00:02:22,800
12 missions that we have

60
00:02:27,350 --> 00:02:25,280
launched since that time

61
00:02:29,430 --> 00:02:27,360
in understanding

62
00:02:31,350 --> 00:02:29,440
what life needs

63
00:02:34,309 --> 00:02:31,360

to exist and what are the environmental

64
00:02:35,910 --> 00:02:34,319
conditions that will favor life now one

65
00:02:37,350 --> 00:02:35,920
of our prime targets has been mars and

66
00:02:40,710 --> 00:02:37,360
that's what we're here for this week to

67
00:02:42,630 --> 00:02:40,720
talk about yet another step in our

68
00:02:44,390 --> 00:02:42,640
search to understand the possibility of

69
00:02:46,949 --> 00:02:44,400
life on mars we've sent

70
00:02:48,949 --> 00:02:46,959
landers in the 70s the viking missions

71
00:02:51,990 --> 00:02:48,959
to do experiments looking for evidence

72
00:02:54,390 --> 00:02:52,000
of metabolism and evidence of life we've

73
00:02:55,990 --> 00:02:54,400
made orbital observations

74
00:02:58,470 --> 00:02:56,000
and deployed other rovers that have

75
00:03:00,949 --> 00:02:58,480
given us evidence of minerals that

76
00:03:02,309 --> 00:03:00,959
suggest that water was present

77
00:03:04,229 --> 00:03:02,319
and features that we can see on the

78
00:03:05,990 --> 00:03:04,239
surface like deltas and rivers and

79
00:03:07,750 --> 00:03:06,000
ripples that are consistent with what we

80
00:03:09,430 --> 00:03:07,760
understand or the actions of water on

81
00:03:11,190 --> 00:03:09,440
our own planet and so we suspect that's

82
00:03:13,589 --> 00:03:11,200
what's going on there as well and

83
00:03:15,270 --> 00:03:13,599
evidence of ice not only at the poles

84
00:03:16,869 --> 00:03:15,280
but in the subsurface away from the

85
00:03:18,630 --> 00:03:16,879
poles

86
00:03:21,750 --> 00:03:18,640
and now we're here today

87
00:03:24,070 --> 00:03:21,760
are this week to talk about msl which is

88
00:03:25,430 --> 00:03:24,080

the next step which is defining

89
00:03:27,030 --> 00:03:25,440
habitability

90
00:03:28,710 --> 00:03:27,040
so one of the ingredients of life is

91
00:03:30,550 --> 00:03:28,720
water we're now looking to see if we can

92
00:03:33,270 --> 00:03:30,560
find other conditions that are necessary

93
00:03:35,190 --> 00:03:33,280
for life by defining habitability or

94
00:03:37,350 --> 00:03:35,200
what does it take in the environment to

95
00:03:40,390 --> 00:03:37,360
support life thank you george all right

96
00:03:42,309 --> 00:03:40,400
thanks mary now to pan conrad the deputy

97
00:03:44,229 --> 00:03:42,319
principal investigator for the sample

98
00:03:47,110 --> 00:03:44,239
analysis at mars from nasa's goddard

99
00:03:49,910 --> 00:03:47,120
space flight center pan

100
00:03:51,509 --> 00:03:49,920
so you're not supposed to do this when

101
00:03:52,869 --> 00:03:51,519
you sit in swivel chairs in a press

102
00:03:54,869 --> 00:03:52,879
conference

103
00:03:56,309 --> 00:03:54,879
but i'm so antsy and so excited that

104
00:03:57,589 --> 00:03:56,319
we're finally here getting ready to

105
00:03:59,670 --> 00:03:57,599
launch because we've been working on

106
00:04:01,350 --> 00:03:59,680
this a really long time

107
00:04:03,110 --> 00:04:01,360
and one reason why it's especially

108
00:04:06,390 --> 00:04:03,120
exciting to me is

109
00:04:08,470 --> 00:04:06,400
my primary research interest is in what

110
00:04:10,949 --> 00:04:08,480
makes places habitable

111
00:04:13,670 --> 00:04:10,959
and i think that astrobiology as a very

112
00:04:15,990 --> 00:04:13,680
broad science has room for all kinds of

113
00:04:18,710 --> 00:04:16,000

questions about life in the universe but

114
00:04:21,110 --> 00:04:18,720
this is to me one of the most exciting

115
00:04:23,270 --> 00:04:21,120
because we have the example of earth and

116
00:04:25,270 --> 00:04:23,280
the example of mars who were formed at

117
00:04:26,870 --> 00:04:25,280
the same time and they look very

118
00:04:28,870 --> 00:04:26,880
differently today

119
00:04:30,950 --> 00:04:28,880
and everything we know about life and

120
00:04:32,310 --> 00:04:30,960
what makes a livable environment on this

121
00:04:37,350 --> 00:04:32,320
planet

122
00:04:39,909 --> 00:04:37,360
to be a tough science question to ask

123
00:04:41,830 --> 00:04:39,919
and answer on mars because what things

124
00:04:43,749 --> 00:04:41,840
look like on mars are a function not

125
00:04:46,230 --> 00:04:43,759
only of the initial set of ingredients

126
00:04:48,870 --> 00:04:46,240
that mars had when it was made but the

127
00:04:50,710 --> 00:04:48,880
processes that have affected mars

128
00:04:53,510 --> 00:04:50,720
so i want to give you a couple of short

129
00:04:55,590 --> 00:04:53,520
examples of things that we might look at

130
00:04:58,469 --> 00:04:55,600
to try to understand the background

131
00:05:01,350 --> 00:04:58,479
environment and what might make it or

132
00:05:02,950 --> 00:05:01,360
maybe not habitable and the reason why

133
00:05:04,150 --> 00:05:02,960
it's so important to study the

134
00:05:08,550 --> 00:05:04,160
environment

135
00:05:13,749 --> 00:05:11,350
now on earth what we really try to look

136
00:05:16,230 --> 00:05:13,759
for when we go into an environment to

137
00:05:18,469 --> 00:05:16,240
assess its potential for habitability

138
00:05:20,790 --> 00:05:18,479

both in the present or perhaps

139
00:05:22,950 --> 00:05:20,800
trapped in the rock record are some

140
00:05:24,469 --> 00:05:22,960
kinds of structures in chemistry that

141
00:05:27,110 --> 00:05:24,479
would tell you

142
00:05:29,830 --> 00:05:27,120
that that rock had had a process acted

143
00:05:31,749 --> 00:05:29,840
upon it that would leave it in a certain

144
00:05:32,790 --> 00:05:31,759
way that might make it favorable for

145
00:05:35,189 --> 00:05:32,800
life

146
00:05:37,029 --> 00:05:35,199
the processes that rework the surface of

147
00:05:38,629 --> 00:05:37,039
the earth they're called sedimentary

148
00:05:41,590 --> 00:05:38,639
processes

149
00:05:43,830 --> 00:05:41,600
and some of the clues are in this rock

150
00:05:45,990 --> 00:05:43,840
so it looks kind of striped

151
00:05:48,070 --> 00:05:46,000
much like a cake i might add

152
00:05:49,590 --> 00:05:48,080
and what that means is that one layer of

153
00:05:51,990 --> 00:05:49,600
sediment got deposited and then

154
00:05:54,390 --> 00:05:52,000
conditions change just a little bit and

155
00:05:57,749 --> 00:05:54,400
you have a distinct boundary between the

156
00:05:59,510 --> 00:05:57,759
next episode of deposition of sediment

157
00:06:01,350 --> 00:05:59,520
and after this stuff got heated and

158
00:06:03,270 --> 00:06:01,360
smooshed together and became a rock you

159
00:06:05,909 --> 00:06:03,280
ended up with these stripes which are

160
00:06:07,990 --> 00:06:05,919
basically a sedimentary structure and

161
00:06:10,150 --> 00:06:08,000
they give you the clue that it is a

162
00:06:12,550 --> 00:06:10,160
sedimentary rock in other words a rock

163
00:06:14,309 --> 00:06:12,560

that has evolved on the surface from all

164
00:06:15,909 --> 00:06:14,319
kinds of processes

165
00:06:18,070 --> 00:06:15,919
the reason we care about this with

166
00:06:20,469 --> 00:06:18,080
respect to mars is because we want to

167
00:06:21,430 --> 00:06:20,479
know how dynamic the surface is or is

168
00:06:23,590 --> 00:06:21,440
not

169
00:06:25,670 --> 00:06:23,600
it's extremely important to remember

170
00:06:28,309 --> 00:06:25,680
that all the life on earth is a function

171
00:06:31,029 --> 00:06:28,319
of well all the stuff on earth and that

172
00:06:33,749 --> 00:06:31,039
we are little bits of earth

173
00:06:34,950 --> 00:06:33,759
so if a biosphere has ever evolved on

174
00:06:37,189 --> 00:06:34,960
mars

175
00:06:38,469 --> 00:06:37,199
that life would be a function of that

176
00:06:40,629 --> 00:06:38,479
environment

177
00:06:43,350 --> 00:06:40,639
we can't say with any definitive

178
00:06:45,029 --> 00:06:43,360
knowledge that we could recognize life

179
00:06:47,350 --> 00:06:45,039
somewhere else in the solar system or

180
00:06:50,150 --> 00:06:47,360
beyond the solar system without being

181
00:06:51,909 --> 00:06:50,160
able to unbolt all the assumptions and

182
00:06:53,110 --> 00:06:51,919
the experience we have with looking at

183
00:06:55,350 --> 00:06:53,120
earth life

184
00:06:56,950 --> 00:06:55,360
we have to remember that any life that

185
00:06:59,189 --> 00:06:56,960
exists somewhere else will be a function

186
00:07:01,430 --> 00:06:59,199
of that environment so mars science

187
00:07:02,469 --> 00:07:01,440
laboratory is off to study that

188
00:07:04,390 --> 00:07:02,479

environment

189
00:07:07,589 --> 00:07:04,400
we're going to learn about the processes

190
00:07:09,830 --> 00:07:07,599
those things that might make it dynamic

191
00:07:11,270 --> 00:07:09,840
we're going to look at some chemicals

192
00:07:13,189 --> 00:07:11,280
that might be consistent with

193
00:07:14,950 --> 00:07:13,199
sedimentary mineralogy that would tell

194
00:07:16,710 --> 00:07:14,960
us something about how much water

195
00:07:19,029 --> 00:07:16,720
activity there's been

196
00:07:21,029 --> 00:07:19,039
what other types of processes might have

197
00:07:23,029 --> 00:07:21,039
affected those rocks and that helps us

198
00:07:25,270 --> 00:07:23,039
reconstruct the history of the surface

199
00:07:27,990 --> 00:07:25,280
environment so that we begin to get a

200
00:07:30,070 --> 00:07:28,000
feel once again for process

201
00:07:32,710 --> 00:07:30,080
this rock that i'm holding is a

202
00:07:35,909 --> 00:07:32,720
sedimentary rock that is the type that

203
00:07:38,870 --> 00:07:35,919
gets precipitated directly from water

204
00:07:41,749 --> 00:07:38,880
so when we say oh we find evidence of

205
00:07:44,550 --> 00:07:41,759
water on mars we're not just talking any

206
00:07:46,070 --> 00:07:44,560
any specific meaning this is a river

207
00:07:48,550 --> 00:07:46,080
this is a place where there was a

208
00:07:50,869 --> 00:07:48,560
standing basin we're also talking the

209
00:07:53,189 --> 00:07:50,879
kinds of minerals that trap the chemical

210
00:07:55,990 --> 00:07:53,199
evidence that water has been there so

211
00:07:58,869 --> 00:07:56,000
this type of rock which is sedimentary

212
00:08:00,869 --> 00:07:58,879
minerals it's it's a carbonate rock

213
00:08:03,110 --> 00:08:00,879

has this kind of mineral because of

214
00:08:04,629 --> 00:08:03,120
sedimentary processes

215
00:08:06,629 --> 00:08:04,639
now if this sounds like so much

216
00:08:08,629 --> 00:08:06,639
chemistry and physics and geology to you

217
00:08:11,510 --> 00:08:08,639
and where's the life in that there's a

218
00:08:13,830 --> 00:08:11,520
lot of life in that once again because

219
00:08:16,469 --> 00:08:13,840
we are the stuff of the place where

220
00:08:18,790 --> 00:08:16,479
we're born and if there has ever been a

221
00:08:21,110 --> 00:08:18,800
biosphere on mars or on any other

222
00:08:23,189 --> 00:08:21,120
celestial object for that matter it's

223
00:08:25,350 --> 00:08:23,199
going to exhibit the characteristics of

224
00:08:27,430 --> 00:08:25,360
those environments so with the very

225
00:08:29,749 --> 00:08:27,440
diverse set of experiments with which

226
00:08:31,510 --> 00:08:29,759
curiosity is equipped we're going to go

227
00:08:34,149 --> 00:08:31,520
to mars and we're going to study all

228
00:08:36,149 --> 00:08:34,159
kinds of sedimentary evidence for the

229
00:08:39,269 --> 00:08:36,159
processes that have affected the surface

230
00:08:42,230 --> 00:08:39,279
of mars and hopefully we'll walk away

231
00:08:43,909 --> 00:08:42,240
with a lot more information about

232
00:08:46,070 --> 00:08:43,919
what environments look like on the

233
00:08:49,030 --> 00:08:46,080
surface of mars i like to say it's

234
00:08:51,030 --> 00:08:49,040
extraterrestrial real estate appraisal

235
00:08:53,750 --> 00:08:51,040
so sometime next

236
00:08:55,430 --> 00:08:53,760
uh let's see yeah sometime next august

237
00:08:57,590 --> 00:08:55,440
early august we should land in gale

238
00:08:59,269 --> 00:08:57,600

crater and we'll have an opportunity to

239
00:09:00,870 --> 00:08:59,279
size up the environment and the next

240
00:09:02,790 --> 00:09:00,880
time you come back hopefully you'll be

241
00:09:05,430 --> 00:09:02,800
hearing a lot more about the potential

242
00:09:09,670 --> 00:09:05,440
for habitability on the surface of mars

243
00:09:10,870 --> 00:09:09,680
george thank you pam next jamie foster

244
00:09:13,190 --> 00:09:10,880
professor for the department of

245
00:09:15,269 --> 00:09:13,200
microbiology and cell science at the

246
00:09:17,430 --> 00:09:15,279
university of florida jamie thank you

247
00:09:19,190 --> 00:09:17,440
george i'm an astrobiologist with the

248
00:09:22,230 --> 00:09:19,200
university of florida and i work on a

249
00:09:24,630 --> 00:09:22,240
type of community called microbiolites

250
00:09:26,710 --> 00:09:24,640
and these are microbial communities that

251
00:09:29,030 --> 00:09:26,720
are important analogs for us to

252
00:09:30,230 --> 00:09:29,040
understand how life evolved on the

253
00:09:31,910 --> 00:09:30,240
planet

254
00:09:33,990 --> 00:09:31,920
and so we specifically

255
00:09:36,389 --> 00:09:34,000
look at these modern microbialites as

256
00:09:37,990 --> 00:09:36,399
examples of looking into the past

257
00:09:40,550 --> 00:09:38,000
with a hope that we can try to

258
00:09:42,230 --> 00:09:40,560
reconstruct the ancient environment and

259
00:09:43,110 --> 00:09:42,240
improve our understanding of the fossil

260
00:09:45,430 --> 00:09:43,120
record

261
00:09:47,590 --> 00:09:45,440
and to get at the basic ingredients of

262
00:09:50,470 --> 00:09:47,600
what's required for life to form and

263
00:09:52,230 --> 00:09:50,480

evolve a major component of astrobiology

264
00:09:54,389 --> 00:09:52,240
so what are microbiolites if i could

265
00:09:56,389 --> 00:09:54,399
have the first slide

266
00:09:58,310 --> 00:09:56,399
so as you can see a few examples of what

267
00:09:59,990 --> 00:09:58,320
living microbites look like they're very

268
00:10:01,829 --> 00:10:00,000
large and they're found in several

269
00:10:03,990 --> 00:10:01,839
places across the globe

270
00:10:06,470 --> 00:10:04,000
and microbes as you can see in the upper

271
00:10:08,630 --> 00:10:06,480
right hand corner of the slide are

272
00:10:10,949 --> 00:10:08,640
dominating these communities and these

273
00:10:13,430 --> 00:10:10,959
microbes take carbon dioxide from the

274
00:10:16,310 --> 00:10:13,440
environment and they sequester it as

275
00:10:19,190 --> 00:10:16,320
minerals such as calcium carbonate and i

276
00:10:20,790 --> 00:10:19,200
have an example here of an example of

277
00:10:23,269 --> 00:10:20,800
that deposition of that calcium

278
00:10:25,670 --> 00:10:23,279
carbonate and what these microbes do is

279
00:10:27,590 --> 00:10:25,680
they leave behind these geological what

280
00:10:29,670 --> 00:10:27,600
we call biosignatures

281
00:10:32,389 --> 00:10:29,680
or the residuals of life

282
00:10:34,550 --> 00:10:32,399
and so by studying the the composition

283
00:10:36,790 --> 00:10:34,560
of these minerals how these minerals are

284
00:10:38,470 --> 00:10:36,800
laid out in structure we can get an

285
00:10:40,790 --> 00:10:38,480
understanding of the type of microbes

286
00:10:41,509 --> 00:10:40,800
that made these structures

287
00:10:43,350 --> 00:10:41,519
so

288
00:10:45,670 --> 00:10:43,360

we can look at them macroscopically or

289
00:10:48,230 --> 00:10:45,680
microscopically and then again as i to

290
00:10:49,910 --> 00:10:48,240
really reiterate we can reconstruct the

291
00:10:51,910 --> 00:10:49,920
paleo environment and help us and

292
00:10:54,710 --> 00:10:51,920
understand how life came to be on the

293
00:10:56,550 --> 00:10:54,720
planet so how does this relate to the

294
00:10:58,870 --> 00:10:56,560
mars science laboratory

295
00:11:00,470 --> 00:10:58,880
well mars has a very well preserved

296
00:11:02,389 --> 00:11:00,480
environmental history

297
00:11:04,150 --> 00:11:02,399
and if we can understand the

298
00:11:06,630 --> 00:11:04,160
environmental parameters or the

299
00:11:09,750 --> 00:11:06,640
biological potential of how life might

300
00:11:12,470 --> 00:11:09,760
have formed on mars we can correlate

301
00:11:14,389 --> 00:11:12,480
that with our studies of modern examples

302
00:11:16,389 --> 00:11:14,399
of past life here on earth

303
00:11:18,389 --> 00:11:16,399
so we can kind of dovetail in the

304
00:11:20,949 --> 00:11:18,399
results of understanding this biological

305
00:11:23,590 --> 00:11:20,959
potential on mars and correlate it with

306
00:11:26,710 --> 00:11:23,600
the metabolic potential of the organisms

307
00:11:29,269 --> 00:11:26,720
that require to form these biosignatures

308
00:11:30,310 --> 00:11:29,279
and really get at one of the more major

309
00:11:32,550 --> 00:11:30,320
uh questions associated with

310
00:11:34,710 --> 00:11:32,560
astrobiology is how did we come to be

311
00:11:35,670 --> 00:11:34,720
and and how did life evolve on the

312
00:11:36,710 --> 00:11:35,680
planet

313
00:11:39,269 --> 00:11:36,720

george

314
00:11:41,350 --> 00:11:39,279
thank you jamie now to stephen benner

315
00:11:43,430 --> 00:11:41,360
director for the foundation for applied

316
00:11:46,069 --> 00:11:43,440
molecular evolution in gainesville thank

317
00:11:49,750 --> 00:11:46,079
you george one of our jobs of course is

318
00:11:51,990 --> 00:11:49,760
to help you folks explain to your

319
00:11:53,910 --> 00:11:52,000
readers and listeners

320
00:11:55,670 --> 00:11:53,920
what the chemistry is that goes on

321
00:11:56,949 --> 00:11:55,680
behind this is one of the comments that

322
00:11:59,430 --> 00:11:56,959
has been made already is that we're

323
00:12:02,150 --> 00:11:59,440
going to be looking for morphology

324
00:12:04,790 --> 00:12:02,160
things in rocks that lead us to say ah

325
00:12:08,069 --> 00:12:04,800
life was there once or life could be

326
00:12:09,910 --> 00:12:08,079
there with the water deposited rocks

327
00:12:11,750 --> 00:12:09,920
that you heard about a moment ago

328
00:12:13,110 --> 00:12:11,760
i brought a bunch of toys also let me

329
00:12:15,350 --> 00:12:13,120
just put a few of them here just to show

330
00:12:16,870 --> 00:12:15,360
you what we usually do when we teach to

331
00:12:18,949 --> 00:12:16,880
students

332
00:12:20,470 --> 00:12:18,959
let's say that's going to be there

333
00:12:22,230 --> 00:12:20,480
but the bottom line is that there's a

334
00:12:25,030 --> 00:12:22,240
rock okay there's something that looks

335
00:12:26,710 --> 00:12:25,040
like a sample of life there's a rock

336
00:12:29,350 --> 00:12:26,720
that contains something that looks like

337
00:12:31,829 --> 00:12:29,360
a sample of life here as well

338
00:12:34,470 --> 00:12:31,839

here's a rock that looks like it might

339
00:12:36,629 --> 00:12:34,480
be a sample of life as well

340
00:12:38,550 --> 00:12:36,639
and here are some rocks that look like

341
00:12:40,710 --> 00:12:38,560
they might be samples of life as well

342
00:12:42,150 --> 00:12:40,720
now what's the problem the problem is

343
00:12:43,670 --> 00:12:42,160
that some of these rocks that look like

344
00:12:45,509 --> 00:12:43,680
they're supposed to be samples of life

345
00:12:47,829 --> 00:12:45,519
are in fact not so this is for example

346
00:12:50,710 --> 00:12:47,839
not life actually at all

347
00:12:52,389 --> 00:12:50,720
this actually is not life at all either

348
00:12:54,389 --> 00:12:52,399
this is a mineral

349
00:12:56,710 --> 00:12:54,399
formation that occurs without biological

350
00:12:58,790 --> 00:12:56,720
influence this of course for those of

351
00:13:01,590 --> 00:12:58,800
you who have frequented the marvelous

352
00:13:03,509 --> 00:13:01,600
beaches off the shores of florida this

353
00:13:04,470 --> 00:13:03,519
is actually a coral sample not taken not

354
00:13:06,870 --> 00:13:04,480
from far

355
00:13:08,710 --> 00:13:06,880
from here and of course this happens to

356
00:13:11,670 --> 00:13:08,720
be a piece of coprolite it's called

357
00:13:12,710 --> 00:13:11,680
dinosaur poop it's a fossilized poop but

358
00:13:15,430 --> 00:13:12,720
one of the things that you have to

359
00:13:17,509 --> 00:13:15,440
understand is how difficult it is to

360
00:13:19,190 --> 00:13:17,519
look at rocks of this kind and come up

361
00:13:21,509 --> 00:13:19,200
to the conclusion whether there's life

362
00:13:23,190 --> 00:13:21,519
or not and for this reason a lot of what

363
00:13:24,389 --> 00:13:23,200

ends up being discussed and you'll see

364
00:13:26,710 --> 00:13:24,399
this in some of the other press

365
00:13:28,790 --> 00:13:26,720
conferences here with the chem min is

366
00:13:29,910 --> 00:13:28,800
chemistry and the chemistry is often

367
00:13:31,990 --> 00:13:29,920
hard to

368
00:13:33,350 --> 00:13:32,000
explain but let me just use one word

369
00:13:35,190 --> 00:13:33,360
we're going to talk about one thing only

370
00:13:37,269 --> 00:13:35,200
in chemistry that's oxidation

371
00:13:39,269 --> 00:13:37,279
you hear a lot about that in the

372
00:13:40,949 --> 00:13:39,279
discussions of mars

373
00:13:41,590 --> 00:13:40,959
surface and you'll hear a lot of it when

374
00:13:50,870 --> 00:13:41,600
the

375
00:13:54,069 --> 00:13:50,880
oxidation oxidizing oxygen this is uh

376
00:13:55,990 --> 00:13:54,079
water a very simple molecule one oxygen

377
00:13:58,069 --> 00:13:56,000
two hydrogens h2o

378
00:13:59,829 --> 00:13:58,079
two hydrogens one oxygen um and of

379
00:14:02,150 --> 00:13:59,839
course oxygen is everywhere it's it's in

380
00:14:03,750 --> 00:14:02,160
this glass it's all

381
00:14:05,030 --> 00:14:03,760
around us it's believed to be a center

382
00:14:06,629 --> 00:14:05,040
for life and one of the reasons why

383
00:14:08,870 --> 00:14:06,639
we're going to gale crater is because

384
00:14:11,269 --> 00:14:08,880
there's some evidence for recent water

385
00:14:14,389 --> 00:14:11,279
there the difficulty however comes when

386
00:14:15,990 --> 00:14:14,399
ultraviolet light hits mars it's very

387
00:14:18,389 --> 00:14:16,000
important

388
00:14:20,230 --> 00:14:18,399

that few astronauts protect themselves

389
00:14:21,829 --> 00:14:20,240
from ultraviolet light because it's

390
00:14:23,189 --> 00:14:21,839
dangerous to the eyes of course you go

391
00:14:26,710 --> 00:14:23,199
outside in the sun of florida you'll see

392
00:14:29,189 --> 00:14:26,720
that what happens however is that when

393
00:14:32,550 --> 00:14:29,199
ultraviolet light hits water

394
00:14:34,790 --> 00:14:32,560
it breaks apart the bonds and what then

395
00:14:36,790 --> 00:14:34,800
happens is if this happens often enough

396
00:14:39,269 --> 00:14:36,800
you end up having two hydrogens they

397
00:14:41,189 --> 00:14:39,279
recombine to give h2 two atoms of

398
00:14:42,710 --> 00:14:41,199
hydrogen one and this is very light you

399
00:14:44,949 --> 00:14:42,720
can fill balloons with it they don't

400
00:14:47,030 --> 00:14:44,959
sail away it leaves the atmosphere and

401
00:14:48,389 --> 00:14:47,040
what's left behind is

402
00:14:50,790 --> 00:14:48,399
two ohs

403
00:14:53,269 --> 00:14:50,800
and they can form h2o2 which is called

404
00:14:55,110 --> 00:14:53,279
hydrogen peroxide this is an oxygen in

405
00:14:57,110 --> 00:14:55,120
fact it's a well-known oxidant in the

406
00:14:59,590 --> 00:14:57,120
sense that you can buy it in your

407
00:15:01,189 --> 00:14:59,600
grocery store and reason why this is a

408
00:15:02,710 --> 00:15:01,199
important thing in your

409
00:15:04,550 --> 00:15:02,720
drugstore grocery store is because it's

410
00:15:06,069 --> 00:15:04,560
just sterile and it actually sterilizes

411
00:15:07,910 --> 00:15:06,079
things and one of the problems that

412
00:15:09,430 --> 00:15:07,920
we're going to have on mars is that

413
00:15:11,430 --> 00:15:09,440

what's a problem and an opportunity is

414
00:15:13,509 --> 00:15:11,440
that if you take this oxygen you know

415
00:15:15,189 --> 00:15:13,519
hydrogen peroxide and put it in things

416
00:15:17,189 --> 00:15:15,199
what will happen over time is that this

417
00:15:19,829 --> 00:15:17,199
particular material will evolve to give

418
00:15:21,590 --> 00:15:19,839
off oxygen and oxidize things so you're

419
00:15:23,430 --> 00:15:21,600
going to see the bubbles coming out or

420
00:15:26,069 --> 00:15:23,440
oxygen that are being generated that

421
00:15:27,590 --> 00:15:26,079
tends to destroy organic material and

422
00:15:30,629 --> 00:15:27,600
what we're looking for

423
00:15:34,150 --> 00:15:30,639
on mars is evidence of the possibility

424
00:15:35,670 --> 00:15:34,160
of organic material stabilized

425
00:15:37,430 --> 00:15:35,680
so that's going to be a problem but it's

426
00:15:39,030 --> 00:15:37,440
also an opportunity because one of the

427
00:15:41,110 --> 00:15:39,040
other things that was found near the

428
00:15:43,829 --> 00:15:41,120
martian pole is the sample here this is

429
00:15:45,910 --> 00:15:43,839
potassium perchlorate this is a species

430
00:15:48,150 --> 00:15:45,920
that can also give oxygen now it's bad

431
00:15:49,990 --> 00:15:48,160
because it will destroy organic material

432
00:15:53,749 --> 00:15:50,000
which might be there left over from life

433
00:15:55,189 --> 00:15:53,759
on mars or even from mars accident

434
00:15:57,430 --> 00:15:55,199
but of course if you're an astronaut you

435
00:15:59,430 --> 00:15:57,440
go to mars and you want to breathe right

436
00:16:00,949 --> 00:15:59,440
there's oxygen actually present on mars

437
00:16:02,790 --> 00:16:00,959
that you could actually recover from the

438
00:16:04,389 --> 00:16:02,800

surface and actually use

439
00:16:06,550 --> 00:16:04,399
so the one thing

440
00:16:08,230 --> 00:16:06,560
first about structure is it's sometimes

441
00:16:10,389 --> 00:16:08,240
very deceptive and you'll see large

442
00:16:12,710 --> 00:16:10,399
amounts of discussion going on just like

443
00:16:15,749 --> 00:16:12,720
happened with allen hills many

444
00:16:17,910 --> 00:16:15,759
maybe 15 years ago what structures

445
00:16:19,670 --> 00:16:17,920
indicate mars and we need people who are

446
00:16:21,749 --> 00:16:19,680
sitting mostly to my right and to my

447
00:16:23,269 --> 00:16:21,759
left to interpret this as

448
00:16:25,189 --> 00:16:23,279
the second thing we want to warn you

449
00:16:26,550 --> 00:16:25,199
about is there's a lot of oxygen on mars

450
00:16:28,470 --> 00:16:26,560
oxidants on mars they're going to be

451
00:16:31,430 --> 00:16:28,480
destroying the chemical signatures that

452
00:16:34,310 --> 00:16:31,440
might be relied upon for life

453
00:16:36,870 --> 00:16:34,320
that might be bad for our looking at the

454
00:16:39,590 --> 00:16:36,880
life detection things in future missions

455
00:16:40,870 --> 00:16:39,600
it will be however good if you're a

456
00:16:42,870 --> 00:16:40,880
martian

457
00:16:44,870 --> 00:16:42,880
astronaut because as you can see you can

458
00:16:46,629 --> 00:16:44,880
actually generate oxygen from things

459
00:16:49,189 --> 00:16:46,639
that we actually think are on the

460
00:16:50,949 --> 00:16:49,199
surface of mars and use them to breathe

461
00:16:51,829 --> 00:16:50,959
and maybe even go breathe while we're

462
00:16:54,069 --> 00:16:51,839
there

463
00:16:56,710 --> 00:16:54,079

back to you george thanks steve

464
00:16:58,629 --> 00:16:56,720
and our last presentation from catherine

465
00:17:01,030 --> 00:16:58,639
connolly the planetary protection

466
00:17:04,309 --> 00:17:01,040
officer from nasa headquarters thank you

467
00:17:05,990 --> 00:17:04,319
george yes are we alone is such a sad

468
00:17:07,590 --> 00:17:06,000
question it implies that you know we're

469
00:17:09,669 --> 00:17:07,600
all just hovered here cuddled down here

470
00:17:11,669 --> 00:17:09,679
in our single little planet what we

471
00:17:12,789 --> 00:17:11,679
really want to know is is there anybody

472
00:17:14,230 --> 00:17:12,799
out there that's a much more

473
00:17:15,429 --> 00:17:14,240
forward-looking and broad looking

474
00:17:16,549 --> 00:17:15,439
there's we might have all kinds of

475
00:17:17,429 --> 00:17:16,559
friends

476
00:17:18,470 --> 00:17:17,439
um

477
00:17:19,909 --> 00:17:18,480
the

478
00:17:21,510 --> 00:17:19,919
challenge to doing this as has been

479
00:17:23,189 --> 00:17:21,520
alluded to previously is that we know

480
00:17:24,870 --> 00:17:23,199
there's lots of life on earth there's

481
00:17:26,710 --> 00:17:24,880
many microbes on your fingers there's

482
00:17:28,870 --> 00:17:26,720
life everywhere if i touch the surface

483
00:17:30,630 --> 00:17:28,880
of something i leave microbes from my

484
00:17:32,150 --> 00:17:30,640
skin on that surface

485
00:17:33,590 --> 00:17:32,160
so um

486
00:17:36,070 --> 00:17:33,600
we also have the kinds of microbes that

487
00:17:37,590 --> 00:17:36,080
construct this the structures that jamie

488
00:17:39,510 --> 00:17:37,600

studies there are lots of microbes on

489
00:17:40,710 --> 00:17:39,520
earth as well as a small number of big

490
00:17:41,830 --> 00:17:40,720
organisms

491
00:17:43,669 --> 00:17:41,840
um

492
00:17:45,750 --> 00:17:43,679
there are also organisms on earth that

493
00:17:48,150 --> 00:17:45,760
consider us to be food so there's good

494
00:17:49,750 --> 00:17:48,160
organisms neutral organisms and also bad

495
00:17:51,669 --> 00:17:49,760
organisms

496
00:17:53,590 --> 00:17:51,679
the point of planetary protection is to

497
00:17:55,830 --> 00:17:53,600
make sure that when we go to other

498
00:17:57,750 --> 00:17:55,840
places we don't cause problems or have

499
00:17:59,990 --> 00:17:57,760
problems caused by the interaction of

500
00:18:01,990 --> 00:18:00,000
those other places with earth and earth

501
00:18:03,430 --> 00:18:02,000
life in particular if we're going to go

502
00:18:05,190 --> 00:18:03,440
to mars to look for life it would be

503
00:18:08,070 --> 00:18:05,200
really embarrassing if we found earth

504
00:18:09,990 --> 00:18:08,080
life when we got there

505
00:18:11,830 --> 00:18:10,000
the way we do this is by being very

506
00:18:13,909 --> 00:18:11,840
careful when we send spacecraft to other

507
00:18:15,510 --> 00:18:13,919
planets that we don't bring earth life

508
00:18:17,669 --> 00:18:15,520
with the spacecraft that then can

509
00:18:19,190 --> 00:18:17,679
contaminate those locations and also

510
00:18:20,870 --> 00:18:19,200
that when we bring samples back from

511
00:18:22,870 --> 00:18:20,880
other locations that we don't bring back

512
00:18:25,510 --> 00:18:22,880
hazardous organisms or other nasty

513
00:18:28,230 --> 00:18:25,520

things when the samples come back

514
00:18:30,390 --> 00:18:28,240
now it was alluded to the whole process

515
00:18:31,510 --> 00:18:30,400
of mars exploration we have sent life

516
00:18:32,950 --> 00:18:31,520
detection

517
00:18:35,270 --> 00:18:32,960
instruments to mars this was on the

518
00:18:37,110 --> 00:18:35,280
viking spacecraft the viking spacecraft

519
00:18:39,190 --> 00:18:37,120
took very great care to make sure there

520
00:18:41,510 --> 00:18:39,200
was no earth life on those spacecraft

521
00:18:43,029 --> 00:18:41,520
when they were sent to mars and the one

522
00:18:44,950 --> 00:18:43,039
thing that we really very clearly

523
00:18:46,630 --> 00:18:44,960
learned from viking is that sending life

524
00:18:48,710 --> 00:18:46,640
detection experiments to another planet

525
00:18:50,470 --> 00:18:48,720
is really hard

526
00:18:51,590 --> 00:18:50,480
steve mentioned why it might be hard

527
00:18:54,230 --> 00:18:51,600
there's all these different chemical

528
00:18:55,590 --> 00:18:54,240
aspects understanding what you see that

529
00:18:57,110 --> 00:18:55,600
you have seen life when it's right in

530
00:18:58,549 --> 00:18:57,120
front of you or recognizing that

531
00:19:01,029 --> 00:18:58,559
something isn't life when you think it

532
00:19:03,110 --> 00:19:01,039
might be is a really difficult challenge

533
00:19:04,630 --> 00:19:03,120
so in the future the mars programs and

534
00:19:06,470 --> 00:19:04,640
the international mars community would

535
00:19:07,990 --> 00:19:06,480
like to bring samples back to earth so

536
00:19:09,510 --> 00:19:08,000
that we can study those samples in our

537
00:19:11,669 --> 00:19:09,520
best laboratories

538
00:19:13,430 --> 00:19:11,679

and we look for life with the best tools

539
00:19:14,870 --> 00:19:13,440
we have available when we do that

540
00:19:16,549 --> 00:19:14,880
planetary protection will be taking

541
00:19:18,150 --> 00:19:16,559
great care that we don't bring nasty

542
00:19:20,630 --> 00:19:18,160
things back to earth and release the

543
00:19:22,950 --> 00:19:20,640
andromeda strain in public we don't want

544
00:19:26,070 --> 00:19:22,960
to do that but for

545
00:19:27,110 --> 00:19:26,080
missions like msl the constraint is then

546
00:19:28,390 --> 00:19:27,120
bringing

547
00:19:30,390 --> 00:19:28,400
making sure that that mission doesn't

548
00:19:31,750 --> 00:19:30,400
take living organisms to mars it's not a

549
00:19:33,830 --> 00:19:31,760
life detection mission it's not bringing

550
00:19:36,150 --> 00:19:33,840
samples back so the only constraint on

551
00:19:37,590 --> 00:19:36,160
msl is to prevent life from earth

552
00:19:39,590 --> 00:19:37,600
getting to mars and potentially

553
00:19:42,230 --> 00:19:39,600
contaminating that location

554
00:19:43,270 --> 00:19:42,240
and so for msl the real consideration

555
00:19:46,070 --> 00:19:43,280
was that they have to build the

556
00:19:47,510 --> 00:19:46,080
spacecraft to be very clean so when they

557
00:19:49,190 --> 00:19:47,520
were putting the pieces of the

558
00:19:50,870 --> 00:19:49,200
spacecraft together they got washed with

559
00:19:52,549 --> 00:19:50,880
alcohol all of the people who were

560
00:19:54,950 --> 00:19:52,559
touching the spacecraft hardware were

561
00:19:56,789 --> 00:19:54,960
wearing these bunny suits gowns had

562
00:19:59,110 --> 00:19:56,799
their gloves and being very careful not

563
00:20:01,110 --> 00:19:59,120

to send contamination to mars and that

564
00:20:03,270 --> 00:20:01,120
was an extremely successful effort the

565
00:20:05,830 --> 00:20:03,280
msl is the cleanest spacecraft that we

566
00:20:07,190 --> 00:20:05,840
will send to mars since viking and so i

567
00:20:09,110 --> 00:20:07,200
think we're all looking forward to a

568
00:20:11,190 --> 00:20:09,120
very successful mission thank you

569
00:20:14,070 --> 00:20:11,200
catherine and for some concluding

570
00:20:16,470 --> 00:20:14,080
remarks now back to mayor voytech from

571
00:20:17,990 --> 00:20:16,480
nasa headquarters thank you

572
00:20:19,750 --> 00:20:18,000
so we're here today discussing looking

573
00:20:22,149 --> 00:20:19,760
for signs of life

574
00:20:25,510 --> 00:20:22,159
the game is afoot the search is on and

575
00:20:28,149 --> 00:20:25,520
msl is taking a very important step and

576
00:20:30,149 --> 00:20:28,159
and part of it is developing a strategy

577
00:20:32,710 --> 00:20:30,159
for narrowing that search it's going to

578
00:20:34,549 --> 00:20:32,720
look for places that are habitable

579
00:20:37,270 --> 00:20:34,559
either in the past or potentially even

580
00:20:38,789 --> 00:20:37,280
in the future or currently it's doing a

581
00:20:41,110 --> 00:20:38,799
real estate assessment where are those

582
00:20:43,350 --> 00:20:41,120
good schools on mars where might there

583
00:20:45,669 --> 00:20:43,360
be microbes living or or some type of

584
00:20:47,110 --> 00:20:45,679
life but you've also heard here in

585
00:20:49,110 --> 00:20:47,120
addition to strategies and what we

586
00:20:51,190 --> 00:20:49,120
understand about life on earth the

587
00:20:53,190 --> 00:20:51,200
challenges that it's going to pose was

588
00:20:55,669 --> 00:20:53,200

as we move into the future to actually

589
00:20:57,990 --> 00:20:55,679
look for life we know that things that

590
00:21:00,310 --> 00:20:58,000
we know about life on earth sometimes

591
00:21:01,990 --> 00:21:00,320
deceive us ourselves shapes that we know

592
00:21:03,990 --> 00:21:02,000
look familiar and could be coral

593
00:21:06,070 --> 00:21:04,000
actually are a rock formation that forms

594
00:21:08,710 --> 00:21:06,080
the same way that crystal that steve

595
00:21:10,549 --> 00:21:08,720
showed was looked very much like a fern

596
00:21:12,310 --> 00:21:10,559
but actually is a crystal so there's

597
00:21:14,870 --> 00:21:12,320
going to be a challenge in recognizing

598
00:21:17,350 --> 00:21:14,880
it even if it ends up being just like

599
00:21:19,270 --> 00:21:17,360
life as we know it here and then there's

600
00:21:21,110 --> 00:21:19,280
a whole question of what if it isn't

601
00:21:23,430 --> 00:21:21,120
life like we know it on earth it's it

602
00:21:24,950 --> 00:21:23,440
uses different materials it forms

603
00:21:26,870 --> 00:21:24,960
different structures that's also going

604
00:21:29,430 --> 00:21:26,880
to be a challenge and then there's the

605
00:21:32,390 --> 00:21:29,440
issue of making sure as cassie's gone

606
00:21:34,710 --> 00:21:32,400
into detail that we go and when as we go

607
00:21:36,950 --> 00:21:34,720
and we look for life we don't take it

608
00:21:39,590 --> 00:21:36,960
there with us and then misidentify

609
00:21:41,590 --> 00:21:39,600
ourselves as inhabiting a particular

610
00:21:43,590 --> 00:21:41,600
location and i want to just flip through

611
00:21:46,230 --> 00:21:43,600
a few slides at the end to talk about

612
00:21:47,270 --> 00:21:46,240
the targets here of course is where msl

613
00:21:49,750 --> 00:21:47,280

is going

614
00:21:51,190 --> 00:21:49,760
um our favorite neighbor our first real

615
00:21:53,909 --> 00:21:51,200
estate assessment

616
00:21:55,909 --> 00:21:53,919
on mars and then the next slide three

617
00:21:58,230 --> 00:21:55,919
other very important bodies in our solar

618
00:22:01,029 --> 00:21:58,240
system the icy moons of saturn and and

619
00:22:05,029 --> 00:22:01,039
jupiter um we have an uh europa

620
00:22:06,630 --> 00:22:05,039
enceladus and titan and then the final

621
00:22:09,669 --> 00:22:06,640
this is an artist's rendition of an

622
00:22:12,230 --> 00:22:09,679
extra x oh planet or an extrasolar

623
00:22:15,590 --> 00:22:12,240
planet this is a pic

624
00:22:18,230 --> 00:22:15,600
a depiction of a planet orbiting another

625
00:22:19,909 --> 00:22:18,240
star besides our own and this is also

626
00:22:21,110 --> 00:22:19,919
some place that we're considering life

627
00:22:22,870 --> 00:22:21,120
outside

628
00:22:24,470 --> 00:22:22,880
our own solar system

629
00:22:27,590 --> 00:22:24,480
so thank you very much for joining us

630
00:22:29,590 --> 00:22:27,600
today we've introduced you into i hope

631
00:22:31,350 --> 00:22:29,600
uh the role of astrobiology and

632
00:22:33,909 --> 00:22:31,360
strategizing and coming up with a

633
00:22:35,669 --> 00:22:33,919
rationale for this our search and you

634
00:22:37,909 --> 00:22:35,679
can see that we're looking forward to

635
00:22:40,149 --> 00:22:37,919
our future missions

636
00:22:41,830 --> 00:22:40,159
thank you mary we're ready now to take

637
00:22:43,750 --> 00:22:41,840
questions please give your name an

638
00:22:46,390 --> 00:22:43,760

affiliation when the microphone comes to

639
00:22:50,149 --> 00:22:46,400
you marcia marcia done associated press

640
00:22:51,110 --> 00:22:50,159
for dr conrad um do you expect a eureka

641
00:22:53,110 --> 00:22:51,120
moment

642
00:22:54,789 --> 00:22:53,120
in anything that you could possibly get

643
00:22:55,830 --> 00:22:54,799
back in your findings

644
00:22:57,750 --> 00:22:55,840
and

645
00:23:00,230 --> 00:22:57,760
granted you're not a life detecting

646
00:23:02,230 --> 00:23:00,240
instrument but is it conceivable that if

647
00:23:04,950 --> 00:23:02,240
you got really really lucky

648
00:23:06,789 --> 00:23:04,960
you might be able to identify it if it's

649
00:23:09,270 --> 00:23:06,799
there

650
00:23:12,070 --> 00:23:09,280
i think the fear of every scientist is

651
00:23:14,070 --> 00:23:12,080
that the eureka moment might come and

652
00:23:16,549 --> 00:23:14,080
you wouldn't have noticed

653
00:23:19,110 --> 00:23:16,559
and so the the search for life and also

654
00:23:22,390 --> 00:23:19,120
the specific investigation that mars

655
00:23:23,190 --> 00:23:22,400
science laboratory will be conducting

656
00:23:25,590 --> 00:23:23,200
are

657
00:23:28,149 --> 00:23:25,600
part of a larger architecture a strategy

658
00:23:31,190 --> 00:23:28,159
that we hope will lead us to inferences

659
00:23:33,590 --> 00:23:31,200
that will be wonderful for years to come

660
00:23:35,830 --> 00:23:33,600
but again they're part of a whole

661
00:23:38,230 --> 00:23:35,840
architecture of a structured research

662
00:23:40,549 --> 00:23:38,240
program the first part of which

663
00:23:43,590 --> 00:23:40,559

is to understand the environment so that

664
00:23:45,350 --> 00:23:43,600
we know the background of chemistry

665
00:23:47,269 --> 00:23:45,360
of shapes

666
00:23:49,510 --> 00:23:47,279
of other kinds of environmental

667
00:23:52,149 --> 00:23:49,520
indicators that tell us what the martian

668
00:23:53,830 --> 00:23:52,159
environment is really like so that

669
00:23:55,669 --> 00:23:53,840
if we see something that we know is

670
00:23:57,029 --> 00:23:55,679
certainly not a mineral and we see

671
00:23:59,750 --> 00:23:57,039
something and it doesn't look like the

672
00:24:01,590 --> 00:23:59,760
atmosphere we can say okay these are

673
00:24:02,549 --> 00:24:01,600
materials that we need to understand

674
00:24:03,430 --> 00:24:02,559
better

675
00:24:05,269 --> 00:24:03,440
so

676
00:24:08,149 --> 00:24:05,279
do we anticipate that we'll learn a

677
00:24:10,390 --> 00:24:08,159
whole lot about mars absolutely

678
00:24:11,190 --> 00:24:10,400
do we know what specifically that will

679
00:24:12,549 --> 00:24:11,200
be

680
00:24:14,710 --> 00:24:12,559
no clue

681
00:24:16,310 --> 00:24:14,720
but we will learn more than we presently

682
00:24:18,390 --> 00:24:16,320
know about the martian environment and

683
00:24:20,070 --> 00:24:18,400
that should tell us not only

684
00:24:22,789 --> 00:24:20,080
something in specific about that

685
00:24:24,710 --> 00:24:22,799
environment and those processes on mars

686
00:24:26,789 --> 00:24:24,720
but will help inform us a little bit

687
00:24:29,269 --> 00:24:26,799
about the variety of processes in

688
00:24:31,350 --> 00:24:29,279

chemistry that exist in the solar system

689
00:24:33,830 --> 00:24:31,360
because the only thing we know about

690
00:24:34,630 --> 00:24:33,840
biospheres is based upon the one we live

691
00:24:39,909 --> 00:24:34,640
in

692
00:24:43,750 --> 00:24:42,470
that's chris haber united television and

693
00:24:45,830 --> 00:24:43,760
radio

694
00:24:47,669 --> 00:24:45,840
the first question i was wondering um

695
00:24:50,070 --> 00:24:47,679
with the recent discovery of liquid

696
00:24:51,750 --> 00:24:50,080
water on europa what is

697
00:24:53,669 --> 00:24:51,760
are you guys planning something for

698
00:24:54,549 --> 00:24:53,679
europa yet

699
00:24:56,710 --> 00:24:54,559
and

700
00:24:58,149 --> 00:24:56,720
secondly

701
00:25:00,710 --> 00:24:58,159
um

702
00:25:02,950 --> 00:25:00,720
a few

703
00:25:06,149 --> 00:25:02,960
if you're looking for any carbon-based

704
00:25:09,750 --> 00:25:06,159
uh possibly anaerobic

705
00:25:12,950 --> 00:25:09,760
uh microbials or if we even have

706
00:25:14,950 --> 00:25:12,960
any ideas how to look for

707
00:25:16,789 --> 00:25:14,960
other possible life forms that wouldn't

708
00:25:18,549 --> 00:25:16,799
be carbon-based

709
00:25:20,710 --> 00:25:18,559
so i can take that first question about

710
00:25:22,390 --> 00:25:20,720
europa and let me just clarify

711
00:25:24,230 --> 00:25:22,400
we've known for over a decade that there

712
00:25:25,990 --> 00:25:24,240
was water on europa

713
00:25:28,390 --> 00:25:26,000

the key finding that was just reported

714
00:25:29,909 --> 00:25:28,400
last week in nature was a mechanism by

715
00:25:31,590 --> 00:25:29,919
which the oxidants that are formed on

716
00:25:32,549 --> 00:25:31,600
the surface and the reductance of the

717
00:25:34,710 --> 00:25:32,559
core

718
00:25:37,190 --> 00:25:34,720
of europa can actually

719
00:25:39,269 --> 00:25:37,200
be in communication and possibly connect

720
00:25:42,390 --> 00:25:39,279
as a battery would

721
00:25:44,630 --> 00:25:42,400
a flow of energy that could fuel an

722
00:25:46,070 --> 00:25:44,640
ecosystem so that's checking off a

723
00:25:48,070 --> 00:25:46,080
second box as we consider the

724
00:25:50,390 --> 00:25:48,080
possibility of habitability on those icy

725
00:25:51,669 --> 00:25:50,400
planets so we already knew about water

726
00:25:54,710 --> 00:25:51,679
but that

727
00:25:56,549 --> 00:25:54,720
subsurface lake provides a conduit are

728
00:25:58,149 --> 00:25:56,559
we interested in it as i'm sure you all

729
00:26:00,390 --> 00:25:58,159
know the decadal survey that was

730
00:26:02,630 --> 00:26:00,400
recently delivered in the spring

731
00:26:04,390 --> 00:26:02,640
identified two very important questions

732
00:26:06,710 --> 00:26:04,400
as top priorities

733
00:26:08,149 --> 00:26:06,720
for flagship missions one was maurice

734
00:26:11,190 --> 00:26:08,159
sample return and the other was

735
00:26:12,950 --> 00:26:11,200
exploring the jupiter europa system

736
00:26:14,470 --> 00:26:12,960
and so are we interested in it

737
00:26:15,750 --> 00:26:14,480
absolutely

738
00:26:17,750 --> 00:26:15,760

does this

739
00:26:19,830 --> 00:26:17,760
encourage us that it's a good target to

740
00:26:21,750 --> 00:26:19,840
consider absolutely

741
00:26:23,510 --> 00:26:21,760
and we're considering it and continuing

742
00:26:25,990 --> 00:26:23,520
studies because this is not the only

743
00:26:27,510 --> 00:26:26,000
decade we hope we see an exploration

744
00:26:31,029 --> 00:26:27,520
there are many more to come and other

745
00:26:32,710 --> 00:26:31,039
targets to to investigate

746
00:26:35,029 --> 00:26:32,720
i guess i'll comment about the

747
00:26:36,710 --> 00:26:35,039
carbon-based life etc one of the really

748
00:26:38,310 --> 00:26:36,720
cool things about chemistry and what

749
00:26:39,669 --> 00:26:38,320
we've been able to observe throughout

750
00:26:41,669 --> 00:26:39,679
the universe is

751
00:26:43,430 --> 00:26:41,679
minerals are minerals and we see some of

752
00:26:46,789 --> 00:26:43,440
the same kinds of minerals we would

753
00:26:48,630 --> 00:26:46,799
expect on earth in meteor samples of

754
00:26:51,350 --> 00:26:48,640
parent bodies of that is of other

755
00:26:53,590 --> 00:26:51,360
planets and moons asteroids and so forth

756
00:26:55,990 --> 00:26:53,600
and we also see organic molecules in

757
00:26:58,470 --> 00:26:56,000
other places and so what we want to

758
00:27:00,870 --> 00:26:58,480
understand within one environment as

759
00:27:03,590 --> 00:27:00,880
opposed to another environment is what

760
00:27:05,750 --> 00:27:03,600
does the specific collection of minerals

761
00:27:08,149 --> 00:27:05,760
and possibly other types of chemical

762
00:27:11,110 --> 00:27:08,159
reactions that occur tell us about the

763
00:27:13,029 --> 00:27:11,120

potential to have more complicated

764
00:27:15,350 --> 00:27:13,039
things going on like the way you would

765
00:27:16,870 --> 00:27:15,360
need if you were going to be life

766
00:27:19,029 --> 00:27:16,880
whether we expect

767
00:27:20,549 --> 00:27:19,039
life to be made of this or that in one

768
00:27:22,070 --> 00:27:20,559
environment in the solar system as

769
00:27:24,470 --> 00:27:22,080
opposed to another

770
00:27:26,310 --> 00:27:24,480
is is really more the kind of question

771
00:27:28,710 --> 00:27:26,320
you ask a writer

772
00:27:31,830 --> 00:27:28,720
what would you speculate on is the stuff

773
00:27:34,070 --> 00:27:31,840
of you know fun and conjecture

774
00:27:36,070 --> 00:27:34,080
when you try to do an experiment for

775
00:27:37,510 --> 00:27:36,080
something as important as determining

776
00:27:39,190 --> 00:27:37,520
whether or not you understand an

777
00:27:40,789 --> 00:27:39,200
environment or whether or not you think

778
00:27:43,110 --> 00:27:40,799
there may be life elsewhere in the

779
00:27:45,669 --> 00:27:43,120
universe you have to completely cleanse

780
00:27:48,710 --> 00:27:45,679
yourself of assumptions about what you

781
00:27:50,389 --> 00:27:48,720
know of life here and think

782
00:27:52,389 --> 00:27:50,399
at a more fundamental level what do you

783
00:27:55,430 --> 00:27:52,399
know about chemistry

784
00:27:57,590 --> 00:27:55,440
and so one really important thing that i

785
00:28:00,070 --> 00:27:57,600
think we should always keep in mind is

786
00:28:02,789 --> 00:28:00,080
we're trying to not have expectations

787
00:28:04,710 --> 00:28:02,799
but that being said i want to go back to

788
00:28:07,510 --> 00:28:04,720

what we're really going to do on mars

789
00:28:09,430 --> 00:28:07,520
science laboratory which is not go on a

790
00:28:10,630 --> 00:28:09,440
survey looking for

791
00:28:13,510 --> 00:28:10,640
all of the

792
00:28:16,149 --> 00:28:13,520
organisms much like we did on galapagos

793
00:28:17,909 --> 00:28:16,159
many many many years ago on earth we're

794
00:28:20,389 --> 00:28:17,919
going to mars to try to understand an

795
00:28:22,630 --> 00:28:20,399
environment and as we go there we'll

796
00:28:23,830 --> 00:28:22,640
learn lots about the chemistry of that

797
00:28:26,070 --> 00:28:23,840
environment

798
00:28:27,990 --> 00:28:26,080
and that should help us begin to

799
00:28:29,590 --> 00:28:28,000
have new ideas that are not so

800
00:28:31,750 --> 00:28:29,600
earth-centric

801
00:28:33,909 --> 00:28:31,760
one last word on that nasa

802
00:28:35,669 --> 00:28:33,919
nasa did team up with the national

803
00:28:37,990 --> 00:28:35,679
research council national academy of

804
00:28:39,590 --> 00:28:38,000
sciences in 2004

805
00:28:41,269 --> 00:28:39,600
published a book which i co-authored

806
00:28:43,269 --> 00:28:41,279
with john barros who's a professor at

807
00:28:45,350 --> 00:28:43,279
university of washington seattle looking

808
00:28:47,590 --> 00:28:45,360
for the limits of

809
00:28:49,110 --> 00:28:47,600
organic life in the solar system what's

810
00:28:50,470 --> 00:28:49,120
called the weird life report if you give

811
00:28:52,789 --> 00:28:50,480
me your card afterwards i'll see that

812
00:28:54,389 --> 00:28:52,799
you can get a copy

813
00:28:55,430 --> 00:28:54,399

basically if you look at us as sort of

814
00:28:56,950 --> 00:28:55,440
the model

815
00:28:58,310 --> 00:28:56,960
right and you start saying how could we

816
00:29:00,389 --> 00:28:58,320
be different from us the first thing we

817
00:29:02,389 --> 00:29:00,399
would do is get away from the 20 amino

818
00:29:04,230 --> 00:29:02,399
acids that you you know have in the

819
00:29:06,389 --> 00:29:04,240
health food store maybe not lysine maybe

820
00:29:08,149 --> 00:29:06,399
not methionine maybe something else the

821
00:29:10,630 --> 00:29:08,159
second thing we would do is maybe change

822
00:29:12,310 --> 00:29:10,640
the dna structures that we have so if

823
00:29:14,149 --> 00:29:12,320
you listen to the movie et you will

824
00:29:17,029 --> 00:29:14,159
notice that et has six letters in his

825
00:29:18,549 --> 00:29:17,039
dna alphabet not four like we have

826
00:29:20,389 --> 00:29:18,559
then the next thing we might worry about

827
00:29:23,110 --> 00:29:20,399
is going to a solvent other than water

828
00:29:25,269 --> 00:29:23,120
so very much so in titan where the

829
00:29:26,950 --> 00:29:25,279
surface of titan is a hydrocarbon ocean

830
00:29:29,750 --> 00:29:26,960
propane

831
00:29:31,990 --> 00:29:29,760
100 degrees kelvin cold

832
00:29:33,909 --> 00:29:32,000
and then and then and only then do we

833
00:29:35,990 --> 00:29:33,919
get away from carbon in our sort of

834
00:29:37,350 --> 00:29:36,000
hierarchy of possibilities

835
00:29:39,510 --> 00:29:37,360
so you know

836
00:29:41,669 --> 00:29:39,520
as pan says we don't want to have a lot

837
00:29:43,190 --> 00:29:41,679
of preconceptions we want to consider

838
00:29:46,149 --> 00:29:43,200

that if you know

839
00:29:48,149 --> 00:29:46,159
tim allen you know this galaxy quest

840
00:29:49,909 --> 00:29:48,159
alien rock creature comes up and bangs

841
00:29:52,830 --> 00:29:49,919
us on the head we don't want to ignore

842
00:29:55,830 --> 00:29:52,840
it that would be the aha moment that we

843
00:29:56,549 --> 00:29:55,840
would regret having missed but

844
00:29:59,590 --> 00:29:56,559
that's

845
00:30:01,909 --> 00:29:59,600
relatively long way down in our our what

846
00:30:03,269 --> 00:30:01,919
if scenarios and you can read that in

847
00:30:05,269 --> 00:30:03,279
this report which i'll be happy to get a

848
00:30:08,710 --> 00:30:05,279
copy to you

849
00:30:10,630 --> 00:30:08,720
question over here

850
00:30:12,950 --> 00:30:10,640
oh yeah hi mike wahl from space.com one

851
00:30:14,310 --> 00:30:12,960
of the things that sam is actually going

852
00:30:15,430 --> 00:30:14,320
to look for is actually i mean carbon

853
00:30:17,430 --> 00:30:15,440
containing

854
00:30:18,950 --> 00:30:17,440
stuff i mean i was just hoping you guys

855
00:30:21,190 --> 00:30:18,960
could could just go into a little detail

856
00:30:23,029 --> 00:30:21,200
do you expect there to to actually be i

857
00:30:25,110 --> 00:30:23,039
mean carbon compounds on the surface and

858
00:30:28,070 --> 00:30:25,120
is it going to be tough to find i mean

859
00:30:31,029 --> 00:30:28,080
if it is there in small concentrations

860
00:30:32,149 --> 00:30:31,039
well the good news is that following

861
00:30:34,230 --> 00:30:32,159
this briefing there's going to be

862
00:30:35,990 --> 00:30:34,240
another briefing and the principal

863
00:30:37,110 --> 00:30:36,000

investigator of sam paul mahaffey will

864
00:30:39,110 --> 00:30:37,120
be able to

865
00:30:41,510 --> 00:30:39,120
address this in more detail but just to

866
00:30:44,149 --> 00:30:41,520
sort of briefly answer your question

867
00:30:46,149 --> 00:30:44,159
we know there are carbon compounds on

868
00:30:47,430 --> 00:30:46,159
mars because the atmosphere has carbon

869
00:30:49,269 --> 00:30:47,440
dioxide

870
00:30:51,909 --> 00:30:49,279
and one of the reasons why carbon is so

871
00:30:53,909 --> 00:30:51,919
important to us is because it has a form

872
00:30:56,630 --> 00:30:53,919
that's sort of oxidized which is the

873
00:30:59,110 --> 00:30:56,640
carbon dioxide and then there are the

874
00:31:00,549 --> 00:30:59,120
more reduced forms that make organic

875
00:31:03,269 --> 00:31:00,559
molecules

876
00:31:06,549 --> 00:31:03,279
one reason why we want to understand

877
00:31:09,350 --> 00:31:06,559
what kind of chemistry you can do on

878
00:31:11,590 --> 00:31:09,360
mars is because minerals make the same

879
00:31:13,509 --> 00:31:11,600
kind of bonds all the time they're

880
00:31:15,350 --> 00:31:13,519
mostly what we call ionic bonds and they

881
00:31:17,350 --> 00:31:15,360
form certain crystal shapes and then

882
00:31:18,710 --> 00:31:17,360
occasionally you have water incorporated

883
00:31:21,430 --> 00:31:18,720
into the minerals and that could be a

884
00:31:23,830 --> 00:31:21,440
hydrogen bond but carbon is special

885
00:31:26,710 --> 00:31:23,840
because of the types of chemical bonds

886
00:31:28,470 --> 00:31:26,720
it makes and it is something that we

887
00:31:31,190 --> 00:31:28,480
would want to understand

888
00:31:34,549 --> 00:31:31,200

the sources and sinks for it on mars and

889
00:31:37,110 --> 00:31:34,559
so we we anticipate learning a lot about

890
00:31:39,669 --> 00:31:37,120
carbon whether or not we will see carbon

891
00:31:42,149 --> 00:31:39,679
mostly as oxidized or mostly as reduced

892
00:31:43,909 --> 00:31:42,159
forms we don't know yet but sam is

893
00:31:45,830 --> 00:31:43,919
designed to look for that and as i said

894
00:31:48,470 --> 00:31:45,840
uh paul mahaffey will talk a lot more

895
00:31:49,590 --> 00:31:48,480
about that shortly and there is also the

896
00:31:51,669 --> 00:31:49,600
question of course

897
00:31:53,830 --> 00:31:51,679
uh plastics have carbon in them and we

898
00:31:55,190 --> 00:31:53,840
know the spacecraft is carrying plastic

899
00:31:56,710 --> 00:31:55,200
so there still is the constraint of

900
00:31:58,310 --> 00:31:56,720
being able to understand what we brought

901
00:31:59,750 --> 00:31:58,320
with us versus what we're seeing that's

902
00:32:01,430 --> 00:31:59,760
actually there

903
00:32:04,710 --> 00:32:01,440
let me just add one comment to that i

904
00:32:07,350 --> 00:32:04,720
mean as i mentioned and as the oxygen

905
00:32:09,509 --> 00:32:07,360
is spilling over in the room right mars

906
00:32:11,669 --> 00:32:09,519
has the ability to oxidize the organic

907
00:32:13,430 --> 00:32:11,679
molecules that we know come to mars by

908
00:32:14,870 --> 00:32:13,440
meteorites come they fall on mars they

909
00:32:15,990 --> 00:32:14,880
contain carbon

910
00:32:18,549 --> 00:32:16,000
there is

911
00:32:20,630 --> 00:32:18,559
this specimen which is a example of

912
00:32:22,789 --> 00:32:20,640
carbon that's still not carbon dioxide

913
00:32:24,310 --> 00:32:22,799

it's relatively highly oxidized but it's

914
00:32:25,990 --> 00:32:24,320
fairly stable and if i weren't sitting

915
00:32:27,590 --> 00:32:26,000
in a carpeted room i'd strike a match

916
00:32:29,990 --> 00:32:27,600
and show you how stable that is to

917
00:32:32,230 --> 00:32:30,000
further oxidation so some of us have a

918
00:32:33,909 --> 00:32:32,240
five dollar bet on this being an organic

919
00:32:35,990 --> 00:32:33,919
molecule that would be found on mars

920
00:32:37,509 --> 00:32:36,000
because it's a end point of the

921
00:32:39,190 --> 00:32:37,519
oxidation that we believe that occurs

922
00:32:40,549 --> 00:32:39,200
but not so much of an end point that it

923
00:32:42,950 --> 00:32:40,559
gets all the way to gaseous carbon

924
00:32:45,029 --> 00:32:42,960
dioxide so yeah i mean we're desperate

925
00:32:46,549 --> 00:32:45,039
to find stuff on mars there are things

926
00:32:47,830 --> 00:32:46,559
on that

927
00:32:50,470 --> 00:32:47,840
science laboratory which have the

928
00:32:51,750 --> 00:32:50,480
capability of finding organic materials

929
00:32:53,110 --> 00:32:51,760
on mars

930
00:32:55,350 --> 00:32:53,120
and if we can find them that's going to

931
00:32:58,630 --> 00:32:55,360
be a big strike for habitability in the

932
00:32:58,640 --> 00:33:02,149
kid

933
00:33:06,630 --> 00:33:05,110
for pan uh and anyone else um maybe a

934
00:33:09,110 --> 00:33:06,640
little repetitive but i wonder if you

935
00:33:10,789 --> 00:33:09,120
could give us a few examples of how

936
00:33:13,269 --> 00:33:10,799
sam is going to operate and look at

937
00:33:16,310 --> 00:33:13,279
those rocks and looking for signs of

938
00:33:18,710 --> 00:33:16,320

life and and and the ingredients of life

939
00:33:20,630 --> 00:33:18,720
what have you done to take into account

940
00:33:22,789 --> 00:33:20,640
what what steve benner better mentioned

941
00:33:26,070 --> 00:33:22,799
about the oxidation that we discovered

942
00:33:27,750 --> 00:33:26,080
with the viking and and and and phoenix

943
00:33:30,630 --> 00:33:27,760
with the perchlorates and the peroxide

944
00:33:32,230 --> 00:33:30,640
what what have you done on on sam to

945
00:33:35,350 --> 00:33:32,240
determine that whether they are there

946
00:33:39,269 --> 00:33:35,360
and how you'll account for that thanks

947
00:33:40,870 --> 00:33:39,279
so uh for those of you that don't

948
00:33:43,350 --> 00:33:40,880
have the background on this so the

949
00:33:45,029 --> 00:33:43,360
sample analysis at mars or or sam

950
00:33:48,389 --> 00:33:45,039
instrument suite

951
00:33:50,789 --> 00:33:48,399
is equipped with the ability to ingest

952
00:33:53,269 --> 00:33:50,799
solid samples powders of rock

953
00:33:55,750 --> 00:33:53,279
as well as the ability to breathe the

954
00:33:57,430 --> 00:33:55,760
martian atmosphere indirectly

955
00:33:58,710 --> 00:33:57,440
and so the reason why we're so

956
00:34:00,710 --> 00:33:58,720
interested in understanding the

957
00:34:02,630 --> 00:34:00,720
chemistry of mars

958
00:34:04,389 --> 00:34:02,640
goes back to what i was saying earlier

959
00:34:06,789 --> 00:34:04,399
and several of us have said and that is

960
00:34:08,869 --> 00:34:06,799
you're basically trying to understand

961
00:34:11,430 --> 00:34:08,879
what the environment is there and then

962
00:34:13,510 --> 00:34:11,440
figure out what processes have gone on

963
00:34:16,710 --> 00:34:13,520

in that environment and we keep bringing

964
00:34:19,430 --> 00:34:16,720
up oxidation and oxidation and reduction

965
00:34:21,990 --> 00:34:19,440
living things make their business their

966
00:34:24,550 --> 00:34:22,000
commerce is basically the exchange of

967
00:34:26,149 --> 00:34:24,560
electrons buying them and selling them

968
00:34:28,470 --> 00:34:26,159
and that's one reason why we're so

969
00:34:29,750 --> 00:34:28,480
interested in oxidation and reduction

970
00:34:31,909 --> 00:34:29,760
chemistry

971
00:34:35,430 --> 00:34:31,919
so your question what is sam going to do

972
00:34:36,790 --> 00:34:35,440
about this first of all sam does not

973
00:34:39,109 --> 00:34:36,800
operate alone

974
00:34:41,909 --> 00:34:39,119
sam operates within the context of a

975
00:34:43,589 --> 00:34:41,919
whole suite of instruments which will

976
00:34:45,430 --> 00:34:43,599
help us to do a very careful

977
00:34:48,310 --> 00:34:45,440
characterization of all the chemistry

978
00:34:51,589 --> 00:34:48,320
that we can on mars but as we look at

979
00:34:53,990 --> 00:34:51,599
rocks that we would call oxidized rocks

980
00:34:55,909 --> 00:34:54,000
or those kinds of

981
00:34:57,829 --> 00:34:55,919
signs of

982
00:35:00,150 --> 00:34:57,839
the type of chemistry that steve

983
00:35:01,670 --> 00:35:00,160
demonstrated that have been oxidized

984
00:35:04,310 --> 00:35:01,680
that tells us something about how

985
00:35:06,630 --> 00:35:04,320
chemically reactive those rocks are

986
00:35:08,870 --> 00:35:06,640
if we looked at other rocks say we found

987
00:35:11,270 --> 00:35:08,880
some pyrite or something that would tell

988
00:35:13,190 --> 00:35:11,280

us about another type of chemistry where

989
00:35:16,150 --> 00:35:13,200
we would say the rock is in a reduced

990
00:35:17,910 --> 00:35:16,160
phase doesn't have a lot of free oxygen

991
00:35:19,910 --> 00:35:17,920
the point is we want to understand the

992
00:35:22,069 --> 00:35:19,920
range of chemistry

993
00:35:24,550 --> 00:35:22,079
so sam will operate together with other

994
00:35:27,270 --> 00:35:24,560
instruments to try to understand what

995
00:35:29,750 --> 00:35:27,280
the range of chemistry is by looking at

996
00:35:32,470 --> 00:35:29,760
the inventory of chemicals that are in

997
00:35:34,630 --> 00:35:32,480
the materials we study the inventory of

998
00:35:36,310 --> 00:35:34,640
chemicals that are breathed in from the

999
00:35:39,030 --> 00:35:36,320
martian atmosphere

1000
00:35:39,829 --> 00:35:39,040
and we'll start to get a picture of what

1001
00:35:44,470 --> 00:35:39,839
the

1002
00:35:46,870 --> 00:35:44,480
surface of mars now a second question

1003
00:35:49,430 --> 00:35:46,880
that goes with that is what happens if

1004
00:35:51,030 --> 00:35:49,440
you get something that's oxidized

1005
00:35:52,870 --> 00:35:51,040
that's the reason for this diverse

1006
00:35:55,589 --> 00:35:52,880
payload for us all to look at these

1007
00:35:57,910 --> 00:35:55,599
materials together and arrive at some

1008
00:35:59,750 --> 00:35:57,920
potential courses of action to determine

1009
00:36:01,990 --> 00:35:59,760
the next experiment we would do the next

1010
00:36:04,550 --> 00:36:02,000
day and ultimately what we hope we'll

1011
00:36:06,790 --> 00:36:04,560
learn is enough to ask the best set of

1012
00:36:08,630 --> 00:36:06,800
questions for the next mission that goes

1013
00:36:10,310 --> 00:36:08,640

and as we learn about this diverse

1014
00:36:12,710 --> 00:36:10,320
chemistry of mars we can begin to

1015
00:36:14,310 --> 00:36:12,720
compare and contrast that with what we

1016
00:36:16,470 --> 00:36:14,320
know on earth and what we learn in

1017
00:36:18,550 --> 00:36:16,480
meteorites and get a better picture of

1018
00:36:22,069 --> 00:36:18,560
the comparative planetology of our solar

1019
00:36:22,079 --> 00:36:25,510
all right yes right here

1020
00:36:30,150 --> 00:36:27,750
hi uh mitchell landsberg los angeles

1021
00:36:33,190 --> 00:36:30,160
times um i want to ask a really basic

1022
00:36:35,589 --> 00:36:33,200
question which is why do we care uh

1023
00:36:37,270 --> 00:36:35,599
whether there's life on mars is there

1024
00:36:39,990 --> 00:36:37,280
you know is that they're thinking that

1025
00:36:42,390 --> 00:36:40,000
there are practical reasons to to to

1026
00:36:45,430 --> 00:36:42,400
learn this uh is it

1027
00:36:48,630 --> 00:36:45,440
to satisfy our curiosity or is it

1028
00:36:50,470 --> 00:36:48,640
essentially a sort of theological quest

1029
00:36:52,550 --> 00:36:50,480
i think you could say all of the above

1030
00:36:55,430 --> 00:36:52,560
when we first sent the viking missions

1031
00:36:57,109 --> 00:36:55,440
to mars the viking missions a long time

1032
00:36:59,190 --> 00:36:57,119
ago we didn't know that there were

1033
00:37:00,710 --> 00:36:59,200
organisms at the base of the at the

1034
00:37:02,470 --> 00:37:00,720
bottom of the ocean in the mid-ocean

1035
00:37:03,670 --> 00:37:02,480
ridges that were surviving in

1036
00:37:05,190 --> 00:37:03,680
temperatures and pressures that were

1037
00:37:06,470 --> 00:37:05,200
completely impossible for humans to

1038
00:37:07,990 --> 00:37:06,480

tolerate

1039
00:37:10,310 --> 00:37:08,000
at that point we also didn't know that

1040
00:37:11,990 --> 00:37:10,320
there were organisms in the

1041
00:37:14,069 --> 00:37:12,000
hot springs of yellowstone that might be

1042
00:37:15,990 --> 00:37:14,079
able to be used for polymerized chain

1043
00:37:18,630 --> 00:37:16,000
reaction processes we didn't even know

1044
00:37:20,550 --> 00:37:18,640
about dna um western blots a lot of the

1045
00:37:22,390 --> 00:37:20,560
molecular biology that we used today but

1046
00:37:24,310 --> 00:37:22,400
those pcr reaction

1047
00:37:26,150 --> 00:37:24,320
that pcr process polymerase chain

1048
00:37:28,470 --> 00:37:26,160
reaction is widely used in medicine

1049
00:37:31,030 --> 00:37:28,480
today for diagnostics for identifying

1050
00:37:33,430 --> 00:37:31,040
potential for disease in humans the i

1051
00:37:35,510 --> 00:37:33,440
mean it's the the argument that is made

1052
00:37:37,430 --> 00:37:35,520
for exploration anywhere we don't know

1053
00:37:38,710 --> 00:37:37,440
what we're going to find if we don't go

1054
00:37:40,069 --> 00:37:38,720
there we're no we're not going to find

1055
00:37:41,670 --> 00:37:40,079
it

1056
00:37:43,829 --> 00:37:41,680
i would also say that this is a

1057
00:37:46,950 --> 00:37:43,839
fundamental question that was opposed

1058
00:37:48,630 --> 00:37:46,960
500 bc by some of the atomists so

1059
00:37:51,510 --> 00:37:48,640
daedalus wondered

1060
00:37:53,030 --> 00:37:51,520
looking out into the skies you know that

1061
00:37:56,470 --> 00:37:53,040
the idea that there would be life

1062
00:37:58,390 --> 00:37:56,480
nowhere else in the universe was as uh

1063
00:38:01,270 --> 00:37:58,400

as ridiculous to him as thinking you

1064
00:38:03,510 --> 00:38:01,280
would sew a fertile field and get only

1065
00:38:06,550 --> 00:38:03,520
one thing to to grow so they were

1066
00:38:08,870 --> 00:38:06,560
thinking this 500 bc so this is not a

1067
00:38:11,510 --> 00:38:08,880
construct of of our century or the last

1068
00:38:13,670 --> 00:38:11,520
century this is something fundamental of

1069
00:38:16,829 --> 00:38:13,680
fundamental important importance i think

1070
00:38:19,190 --> 00:38:16,839
i believe to to humankind

1071
00:38:23,670 --> 00:38:19,200
is employee almost tempted to throw the

1072
00:38:27,430 --> 00:38:25,589
obviously nasa has the customers the

1073
00:38:28,630 --> 00:38:27,440
american taxpayer and to some extent to

1074
00:38:31,190 --> 00:38:28,640
the world

1075
00:38:32,390 --> 00:38:31,200
and if you go to any opening of any

1076
00:38:34,069 --> 00:38:32,400
hollywood

1077
00:38:35,829 --> 00:38:34,079
movie what is the chance that it will be

1078
00:38:38,230 --> 00:38:35,839
a movie about aliens well the answer is

1079
00:38:39,670 --> 00:38:38,240
the public is interested in this

1080
00:38:42,390 --> 00:38:39,680
second if you want to talk about the

1081
00:38:44,790 --> 00:38:42,400
training and enthusing of young students

1082
00:38:46,550 --> 00:38:44,800
to study science which everybody seems

1083
00:38:49,030 --> 00:38:46,560
to agree is important for a modern

1084
00:38:50,870 --> 00:38:49,040
economy studying chemistry is hard work

1085
00:38:52,870 --> 00:38:50,880
it's not all plastic models fun and

1086
00:38:55,510 --> 00:38:52,880
games and as has been mentioned right

1087
00:38:57,030 --> 00:38:55,520
you go ten years between aha experiences

1088
00:38:58,710 --> 00:38:57,040

and the rest of it is drudgery getting

1089
00:39:00,230 --> 00:38:58,720
the machines to work and you know

1090
00:39:01,349 --> 00:39:00,240
finding that what you thought was true

1091
00:39:03,030 --> 00:39:01,359
is wrong

1092
00:39:05,510 --> 00:39:03,040
way we aspire and when i go to high

1093
00:39:07,109 --> 00:39:05,520
schools or elementary schools if i raise

1094
00:39:10,390 --> 00:39:07,119
a question about whether there are

1095
00:39:12,870 --> 00:39:10,400
aliens life even microbial this gets the

1096
00:39:15,109 --> 00:39:12,880
response that is far more excitement

1097
00:39:16,790 --> 00:39:15,119
than even if i say let's cure cancer

1098
00:39:18,710 --> 00:39:16,800
right i mean this is how we motivate

1099
00:39:21,510 --> 00:39:18,720
people to study and do the hard work to

1100
00:39:23,270 --> 00:39:21,520
study science so i

1101
00:39:24,470 --> 00:39:23,280
would go i almost be tempted except the

1102
00:39:25,750 --> 00:39:24,480
fact that this is a press conference in

1103
00:39:27,190 --> 00:39:25,760
one direction to throw this question

1104
00:39:29,430 --> 00:39:27,200
back to you and your editorial staff as

1105
00:39:33,270 --> 00:39:29,440
to what do you think is an exciting

1106
00:39:37,750 --> 00:39:35,510
roger record arcade eye this question is

1107
00:39:40,230 --> 00:39:37,760
for catherine

1108
00:39:43,030 --> 00:39:40,240
there are limits set on the number of

1109
00:39:44,150 --> 00:39:43,040
spores that you're allowed to take to

1110
00:39:45,910 --> 00:39:44,160
mars

1111
00:39:48,550 --> 00:39:45,920
and you said this was the cleanest

1112
00:39:51,270 --> 00:39:48,560
spacecraft going i'm wondering what

1113
00:39:53,190 --> 00:39:51,280

numbers you found in your testing

1114
00:39:55,270 --> 00:39:53,200
well um

1115
00:39:57,109 --> 00:39:55,280
it was left less it was about half of

1116
00:39:58,710 --> 00:39:57,119
what the requirement is the msl

1117
00:40:01,270 --> 00:39:58,720
spacecraft is about the same level of

1118
00:40:04,230 --> 00:40:01,280
cleanliness on a much larger spacecraft

1119
00:40:06,710 --> 00:40:04,240
as the mer rovers were

1120
00:40:08,150 --> 00:40:06,720
um this is demonstration of the really

1121
00:40:09,829 --> 00:40:08,160
hard work that the people who were hands

1122
00:40:11,910 --> 00:40:09,839
on on the spacecraft did in order to

1123
00:40:13,829 --> 00:40:11,920
keep it at that level of cleanliness it

1124
00:40:16,150 --> 00:40:13,839
also is a demonstration to the

1125
00:40:17,910 --> 00:40:16,160
international community and the policy

1126
00:40:19,349 --> 00:40:17,920
setters that we actually can maintain

1127
00:40:21,510 --> 00:40:19,359
these levels of cleanliness which is

1128
00:40:23,670 --> 00:40:21,520
really nice to know on a big spacecraft

1129
00:40:25,270 --> 00:40:23,680
because if we do go to europa we have

1130
00:40:27,190 --> 00:40:25,280
requirements that are more stringent for

1131
00:40:28,870 --> 00:40:27,200
mars but the demonstration that we

1132
00:40:30,470 --> 00:40:28,880
actually can get to this level means

1133
00:40:31,829 --> 00:40:30,480
that with more work we can do even

1134
00:40:33,349 --> 00:40:31,839
better and

1135
00:40:34,950 --> 00:40:33,359
not only not contaminate mars but

1136
00:40:36,630 --> 00:40:34,960
potentially not contaminate europa when

1137
00:40:38,630 --> 00:40:36,640
we're actually going to potentially send

1138
00:40:39,990 --> 00:40:38,640

a spacecraft into an ocean or it will

1139
00:40:42,309 --> 00:40:40,000
get there eventually even if we don't

1140
00:40:46,069 --> 00:40:42,319
put it there on purpose

1141
00:40:48,309 --> 00:40:46,079
about about 250 300 000 spores is what

1142
00:40:49,670 --> 00:40:48,319
the number and that's just a metric that

1143
00:40:51,589 --> 00:40:49,680
isn't the total number of organisms on

1144
00:40:52,390 --> 00:40:51,599
the spacecraft it's just a way that we

1145
00:40:54,390 --> 00:40:52,400
test

1146
00:40:56,309 --> 00:40:54,400
to show the level of cleanliness but it

1147
00:40:59,990 --> 00:40:56,319
was about half of what the requirement

1148
00:41:02,550 --> 00:41:00,000
is what the maximum allowable is

1149
00:41:04,829 --> 00:41:02,560
right we've got a question on the uh on

1150
00:41:15,990 --> 00:41:04,839
the telephone from denise ciao from

1151
00:41:20,069 --> 00:41:18,150
well apparently she's not there anymore

1152
00:41:22,309 --> 00:41:20,079
so any additional follow-ups here in the

1153
00:41:23,750 --> 00:41:22,319
room

1154
00:41:25,030 --> 00:41:23,760
all right in that event that will

1155
00:41:27,030 --> 00:41:25,040
include

1156
00:41:29,030 --> 00:41:27,040
this briefing a couple of programming

1157
00:41:30,550 --> 00:41:29,040
notes there will be the mars science

1158
00:41:33,030 --> 00:41:30,560
laboratory mission science briefing

1159
00:41:35,910 --> 00:41:33,040
which follows this briefing

1160
00:41:37,430 --> 00:41:35,920
and then tomorrow at 1 pm

1161
00:41:40,309 --> 00:41:37,440
the pre-launch news conference is

1162
00:41:42,069 --> 00:41:40,319
scheduled and that is at that time

1163
00:41:43,109 --> 00:41:42,079

because the launch readiness review will

1164
00:41:45,750 --> 00:41:43,119
have just

1165
00:41:48,470 --> 00:41:45,760
ended a couple of hours before

1166
00:41:49,829 --> 00:41:48,480
so please stay tuned now for our mars