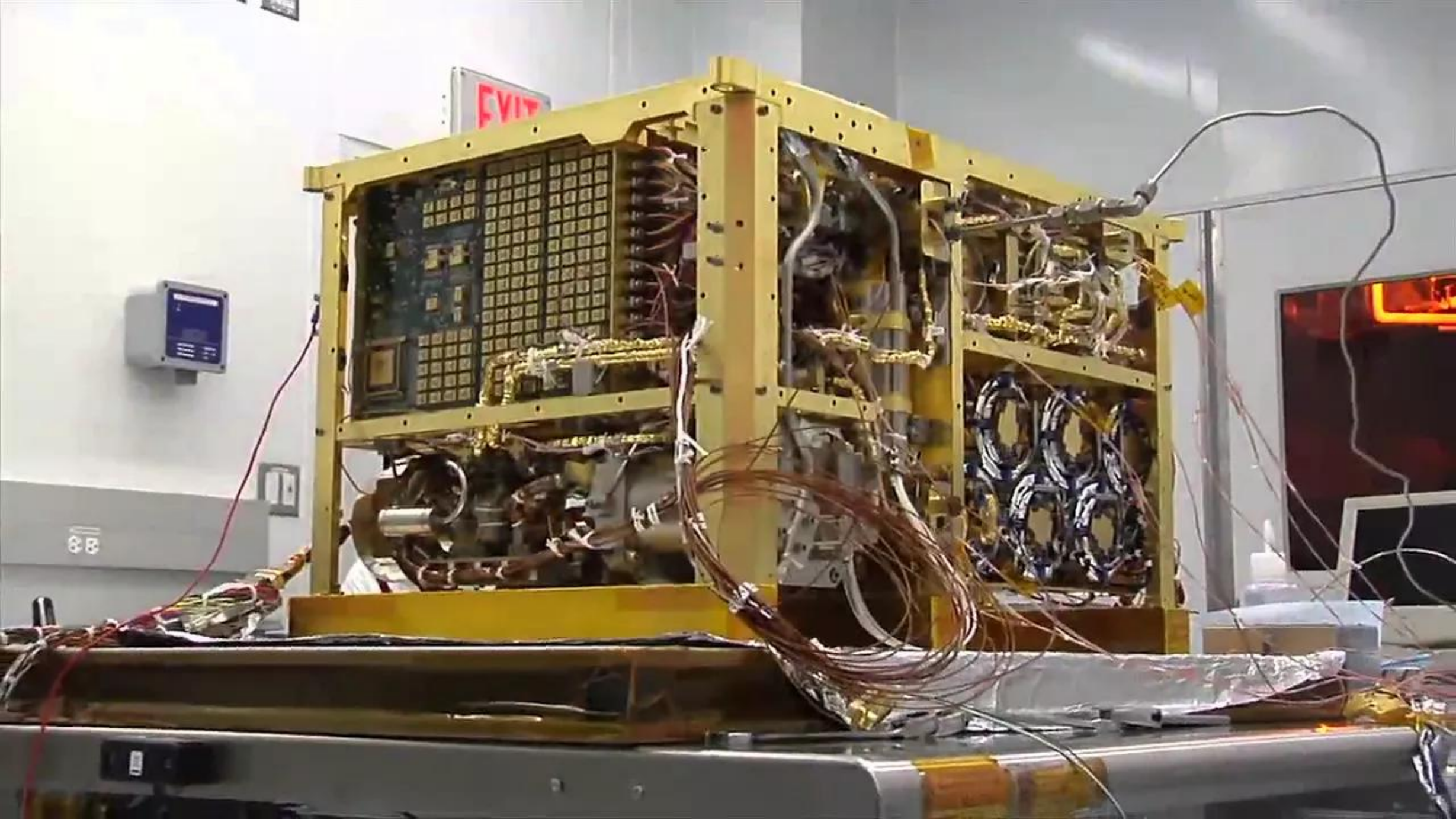
EXIT

1
00:00:04,870 --> 00:00:03,110
good day everyone my name is patty

2
00:00:07,110 --> 00:00:04,880
duncan from discovery education and i

3
00:00:09,430 --> 00:00:07,120
want to welcome you to the white house

4
00:00:12,790 --> 00:00:09,440
and discovery education of the people

5
00:00:15,669 --> 00:00:12,800
series today in honor of space day we

6
00:00:18,150 --> 00:00:15,679
are coming to you live from nasa's

7
00:00:19,269 --> 00:00:18,160
goddard space flight center in greenbelt

8
00:00:21,990 --> 00:00:19,279
maryland

9
00:00:25,189 --> 00:00:22,000
you can join the conversation on twitter

10
00:00:27,109 --> 00:00:25,199
at discovery ed with using the hashtag

11
00:00:29,750 --> 00:00:27,119
of the people

12
00:00:32,229 --> 00:00:29,760
so today we have with us the chief

13
00:00:35,910 --> 00:00:32,239

scientist of the nasa goddard flight

14
00:00:37,910 --> 00:00:35,920
space center dr jim garvin dr garvin

15
00:00:39,750 --> 00:00:37,920
welcome thanks patty and we want to

16
00:00:42,790 --> 00:00:39,760
really thank you for hosting today my

17
00:00:44,630 --> 00:00:42,800
pleasure we've had a lot of students

18
00:00:46,630 --> 00:00:44,640
send in many many questions actually

19
00:00:48,310 --> 00:00:46,640
where we let have like thousands of

20
00:00:49,990 --> 00:00:48,320
questions and

21
00:00:52,709 --> 00:00:50,000
one of the main things that our students

22
00:00:54,310 --> 00:00:52,719
want to know is exactly what is a chief

23
00:00:56,709 --> 00:00:54,320
scientist and what is it that you do

24
00:00:58,709 --> 00:00:56,719
here at goddard so here at goddard we're

25
00:01:01,349 --> 00:00:58,719
a science center with engineers

26
00:01:03,430 --> 00:01:01,359
scientists working together and really

27
00:01:05,270 --> 00:01:03,440
my job is to represent this big

28
00:01:07,590 --> 00:01:05,280
workforce of scientists that explore the

29
00:01:09,990 --> 00:01:07,600
universe rewrite the questions we're

30
00:01:12,550 --> 00:01:10,000
asking as we look at our place in space

31
00:01:14,230 --> 00:01:12,560
where we're going are we alone and so

32
00:01:15,910 --> 00:01:14,240
that collective of women and men

33
00:01:18,070 --> 00:01:15,920
scientists and engineers working

34
00:01:19,830 --> 00:01:18,080
together here at goddard are exploring

35
00:01:21,749 --> 00:01:19,840
our place in space firsthand and i'm

36
00:01:23,429 --> 00:01:21,759
lucky enough to be a part of that team

37
00:01:26,149 --> 00:01:23,439
working with them to make that all

38
00:01:28,469 --> 00:01:26,159

possible for all of you

39
00:01:29,350 --> 00:01:28,479
that sounds like an amazing place to

40
00:01:31,590 --> 00:01:29,360
work

41
00:01:33,429 --> 00:01:31,600
we were lucky enough to come here last

42
00:01:35,510 --> 00:01:33,439
week and take a tour of the goddard

43
00:01:39,030 --> 00:01:35,520
space flight center we'd like to show

44
00:01:42,469 --> 00:01:40,550
welcome to the goddard space flight

45
00:01:44,230 --> 00:01:42,479
center we're here in a special facility

46
00:01:47,510 --> 00:01:44,240
where there are more scientists studying

47
00:01:49,670 --> 00:01:47,520
the universe the earth space the sun

48
00:01:52,230 --> 00:01:49,680
surfaces of planets their interiors than

49
00:01:54,230 --> 00:01:52,240
in any other center at nasa as nasa's

50
00:01:56,389 --> 00:01:54,240
flagship science center here at goddard

51
00:01:57,749 --> 00:01:56,399
we test and build spacecraft that

52
00:02:00,069 --> 00:01:57,759
explore the earth

53
00:02:02,630 --> 00:02:00,079
we test and study and service the hubble

54
00:02:04,789 --> 00:02:02,640
space telescope we study rainfall on

55
00:02:06,389 --> 00:02:04,799
earth we explore the surface of mars

56
00:02:09,190 --> 00:02:06,399
with instruments that look for the signs

57
00:02:11,350 --> 00:02:09,200
of organics and we build the giant

58
00:02:13,750 --> 00:02:11,360
observatories that will extend our

59
00:02:16,150 --> 00:02:13,760
vision back in time with unbelievable

60
00:02:18,710 --> 00:02:16,160
clarity the james webb telescope here in

61
00:02:20,309 --> 00:02:18,720
this very building we've tested aspects

62
00:02:22,630 --> 00:02:20,319
of hubble and we're getting ready to

63
00:02:25,030 --> 00:02:22,640

finish the testing of humanity's

64
00:02:27,030 --> 00:02:25,040
greatest science mission uh james webb

65
00:02:29,190 --> 00:02:27,040
telescope and right over here you can

66
00:02:31,990 --> 00:02:29,200
see the giant thermal vacuum chamber

67
00:02:33,750 --> 00:02:32,000
which simulates the vast recesses of

68
00:02:36,150 --> 00:02:33,760
space so our spacecraft know what

69
00:02:38,630 --> 00:02:36,160
they're in for so here at goddard we

70
00:02:41,270 --> 00:02:38,640
have engineers scientists managers all

71
00:02:43,190 --> 00:02:41,280
working together on nasa's mission to

72
00:02:46,550 --> 00:02:43,200
explore discover and understand our

73
00:02:49,750 --> 00:02:48,150
jim thank you for that introduction of

74
00:02:52,630 --> 00:02:49,760
the goddard space flight center it looks

75
00:02:53,990 --> 00:02:52,640
amazing now before we go and learn a

76
00:02:55,430 --> 00:02:54,000
little bit more about the missions that

77
00:02:56,790 --> 00:02:55,440
are happening here i have a really

78
00:02:59,430 --> 00:02:56,800
important question

79
00:03:01,910 --> 00:02:59,440
didn't you just recently find dinosaur

80
00:03:03,830 --> 00:03:01,920
footprints here on campus absolutely in

81
00:03:06,390 --> 00:03:03,840
fact this is an amazing time here at

82
00:03:08,470 --> 00:03:06,400
goddard one of the first science centers

83
00:03:10,630 --> 00:03:08,480
across all of nasa we have a record of

84
00:03:12,869 --> 00:03:10,640
ancient life just as we're looking for

85
00:03:15,110 --> 00:03:12,879
signs of past life on other worlds and

86
00:03:17,509 --> 00:03:15,120
other in other solar systems perhaps

87
00:03:21,270 --> 00:03:17,519
there is a record of big dinosaurs known

88
00:03:23,190 --> 00:03:21,280

as nodosaurs from the cretaceous 70 75

89
00:03:24,790 --> 00:03:23,200
million years ago that we've found as

90
00:03:26,790 --> 00:03:24,800
we've excavated for new buildings right

91
00:03:29,270 --> 00:03:26,800
here at goddard so it's a concise

92
00:03:31,270 --> 00:03:29,280
connection a juxtaposition between the

93
00:03:33,350 --> 00:03:31,280
history of past life and looking out

94
00:03:35,110 --> 00:03:33,360
across the universe in search of signs

95
00:03:37,830 --> 00:03:35,120
of life beyond

96
00:03:40,149 --> 00:03:37,840
that's a really nice blend of astronomy

97
00:03:42,550 --> 00:03:40,159
geology paleontology

98
00:03:45,110 --> 00:03:42,560
all world together right so our first

99
00:03:47,110 --> 00:03:45,120
question today comes from christina at

100
00:03:49,910 --> 00:03:47,120
school 32 in new york and christina

101
00:03:52,390 --> 00:03:49,920
wants to know what other jobs could

102
00:03:54,390 --> 00:03:52,400
someone have here at nasa if they

103
00:03:56,390 --> 00:03:54,400
weren't interested in being an astronaut

104
00:03:58,630 --> 00:03:56,400
well great question christina thanks

105
00:04:01,670 --> 00:03:58,640
here at goddard for example we have 9

106
00:04:04,309 --> 00:04:01,680
000 employees we have everything from

107
00:04:07,670 --> 00:04:04,319
scientists mathematicians engineers that

108
00:04:10,470 --> 00:04:07,680
build telescopes spacecraft instruments

109
00:04:13,110 --> 00:04:10,480
to artists communicators animators

110
00:04:15,030 --> 00:04:13,120
social media experts financial analysts

111
00:04:17,030 --> 00:04:15,040
that figure out where we send the money

112
00:04:19,349 --> 00:04:17,040
to do all this cool stuff there's really

113
00:04:21,430 --> 00:04:19,359

a place for almost anyone to work here

114
00:04:22,950 --> 00:04:21,440
at nasa as we explore the universe to

115
00:04:25,189 --> 00:04:22,960
find out really

116
00:04:27,430 --> 00:04:25,199
what's our place in space

117
00:04:29,749 --> 00:04:27,440
got a job for me i will take you

118
00:04:31,749 --> 00:04:29,759
i'd take that in a minute all right so i

119
00:04:34,469 --> 00:04:31,759
know that we are celebrating space day

120
00:04:35,990 --> 00:04:34,479
today but didn't you just recently have

121
00:04:38,390 --> 00:04:36,000
another celebration involving your

122
00:04:41,430 --> 00:04:38,400
hubble telescope we did nasa's really

123
00:04:43,590 --> 00:04:41,440
proud this is the 25th anniversary of

124
00:04:46,310 --> 00:04:43,600
the flight of the hubble space telescope

125
00:04:48,070 --> 00:04:46,320
really an engine of science robots and

126
00:04:50,150 --> 00:04:48,080
people working together actually to

127
00:04:52,790 --> 00:04:50,160
explore the cosmos look at our solar

128
00:04:55,030 --> 00:04:52,800
system look beyond really humanity's

129
00:04:57,909 --> 00:04:55,040
portal into the universe and so hubble's

130
00:05:00,070 --> 00:04:57,919
done 25 years worth of work and in fact

131
00:05:02,310 --> 00:05:00,080
we're here designing the successor to

132
00:05:04,390 --> 00:05:02,320
hubble known as the james webb

133
00:05:06,629 --> 00:05:04,400
right so the james webb telescope is

134
00:05:09,510 --> 00:05:06,639
going to take over hubble is 25 years

135
00:05:11,749 --> 00:05:09,520
old reaching the end of its run and now

136
00:05:14,469 --> 00:05:11,759
you're excited to be bringing the james

137
00:05:17,189 --> 00:05:14,479
webb forward so erica from john m

138
00:05:17,990 --> 00:05:17,199

mccloud school in nova scotia wants to

139
00:05:20,390 --> 00:05:18,000
know

140
00:05:23,350 --> 00:05:20,400
more about this replacement telescope

141
00:05:26,070 --> 00:05:23,360
and we were lucky enough to

142
00:05:28,629 --> 00:05:26,080
find out some more about the hubble when

143
00:05:30,950 --> 00:05:28,639
we were visiting last week so let's see

144
00:05:33,110 --> 00:05:30,960
what that's all about

145
00:05:34,950 --> 00:05:33,120
my name is laura betts and i'm one of

146
00:05:37,590 --> 00:05:34,960
the science writers who's working on the

147
00:05:40,070 --> 00:05:37,600
james webb space telescope it's not only

148
00:05:42,070 --> 00:05:40,080
the largest space telescope that we've

149
00:05:44,150 --> 00:05:42,080
ever launched out into space

150
00:05:45,590 --> 00:05:44,160
but it's going to be seeing things so

151
00:05:47,029 --> 00:05:45,600
differently than we've ever seen them

152
00:05:49,430 --> 00:05:47,039
before

153
00:05:51,670 --> 00:05:49,440
it's going to be diving back deeper into

154
00:05:53,189 --> 00:05:51,680
the universe and see light from just

155
00:05:55,510 --> 00:05:53,199
after the big bang

156
00:05:57,350 --> 00:05:55,520
and i am so fortunate because i get to

157
00:05:59,029 --> 00:05:57,360
write about the scientists and engineers

158
00:06:01,029 --> 00:05:59,039
that are building this telescope the

159
00:06:02,710 --> 00:06:01,039
james webb space telescope is the

160
00:06:04,469 --> 00:06:02,720
successor to hubble

161
00:06:07,189 --> 00:06:04,479
and how it's different than hubble is

162
00:06:08,950 --> 00:06:07,199
that it's a lot larger than hubble so

163
00:06:11,590 --> 00:06:08,960

hubble's about the size of school bus

164
00:06:13,510 --> 00:06:11,600
and is about 350 miles above earth

165
00:06:16,469 --> 00:06:13,520
webb's going a million miles out into

166
00:06:18,790 --> 00:06:16,479
space and is the size of a jet plane

167
00:06:20,629 --> 00:06:18,800
this telescope is so sensitive it would

168
00:06:22,870 --> 00:06:20,639
be able to see the details on a penny

169
00:06:24,710 --> 00:06:22,880
from 24 miles away if you're looking at

170
00:06:27,670 --> 00:06:24,720
the james webb space telescope you can

171
00:06:30,070 --> 00:06:27,680
see that there are 18 hexagonal mirrors

172
00:06:31,749 --> 00:06:30,080
that form its mirror that's seven times

173
00:06:33,909 --> 00:06:31,759
larger than hubble's

174
00:06:36,870 --> 00:06:33,919
so each one of these mirrors weighs

175
00:06:38,309 --> 00:06:36,880
about 50 pounds and they're very special

176
00:06:40,790 --> 00:06:38,319
because they're made of beryllium which

177
00:06:42,790 --> 00:06:40,800
is actually a toxic substance and on

178
00:06:45,189 --> 00:06:42,800
tops of the mirrors there's a very fine

179
00:06:47,350 --> 00:06:45,199
film of gold about the amount of a

180
00:06:49,749 --> 00:06:47,360
wedding ring size that was vaporized

181
00:06:51,430 --> 00:06:49,759
spread across the top of the mirror this

182
00:06:53,670 --> 00:06:51,440
is very important for the kind of light

183
00:06:55,670 --> 00:06:53,680
that it's studying and in order for it

184
00:06:57,749 --> 00:06:55,680
to open up into space it opens up like

185
00:07:00,070 --> 00:06:57,759
the eaves of a table

186
00:07:02,629 --> 00:07:00,080
the clean room here at goddard is the

187
00:07:04,550 --> 00:07:02,639
world's largest clean room and it's a

188
00:07:05,830 --> 00:07:04,560

thousand times more sterile than an

189
00:07:08,230 --> 00:07:05,840
operating room

190
00:07:10,390 --> 00:07:08,240
and it's important because we're working

191
00:07:12,629 --> 00:07:10,400
with very sensitive optics and there

192
00:07:13,830 --> 00:07:12,639
can't be any dust or any particulates on

193
00:07:17,270 --> 00:07:13,840
it

194
00:07:20,309 --> 00:07:17,280
in the clean room here we have all 18 of

195
00:07:22,150 --> 00:07:20,319
these mirrors and we also have all four

196
00:07:24,150 --> 00:07:22,160
of the science instruments

197
00:07:26,070 --> 00:07:24,160
so the way that it works the telescope

198
00:07:29,270 --> 00:07:26,080
works is light comes in from the distant

199
00:07:31,589 --> 00:07:29,280
universe hits the primary mirror

200
00:07:33,430 --> 00:07:31,599
bounces off the secondary mirror and

201
00:07:35,350 --> 00:07:33,440
goes into the telescope and then is

202
00:07:37,110 --> 00:07:35,360
split off and bounces around and hits

203
00:07:38,469 --> 00:07:37,120
all the science instruments that are

204
00:07:40,070 --> 00:07:38,479
studying it

205
00:07:43,029 --> 00:07:40,080
we're trying to learn about the

206
00:07:45,589 --> 00:07:43,039
formations of stars and galaxies we've

207
00:07:48,710 --> 00:07:45,599
learned a lot from hubble about stars

208
00:07:50,550 --> 00:07:48,720
and galaxies at their youth and in high

209
00:07:52,790 --> 00:07:50,560
school age but what we really want to

210
00:07:55,029 --> 00:07:52,800
focus on is what's happening in the

211
00:07:57,510 --> 00:07:55,039
infant and toddler stages

212
00:07:58,390 --> 00:07:57,520
we're expecting a lot of surprises

213
00:08:01,350 --> 00:07:58,400

hubble

214
00:08:02,710 --> 00:08:01,360
was so amazing because it made us

215
00:08:04,790 --> 00:08:02,720
realize that there are so many more

216
00:08:06,790 --> 00:08:04,800
questions that we should be asking

217
00:08:08,150 --> 00:08:06,800
and our scientists here say that this

218
00:08:09,990 --> 00:08:08,160
telescope is going to create an

219
00:08:10,950 --> 00:08:10,000
avalanche of discoveries

220
00:08:12,869 --> 00:08:10,960
so

221
00:08:15,029 --> 00:08:12,879
we are going to look back at the

222
00:08:17,189 --> 00:08:15,039
formations of stars and galaxies in a

223
00:08:19,270 --> 00:08:17,199
way that we haven't been able to

224
00:08:21,110 --> 00:08:19,280
so when stars and galaxies are forming

225
00:08:22,790 --> 00:08:21,120
there's a lot of gas and dust swirling

226
00:08:25,270 --> 00:08:22,800
around them so hubble took these

227
00:08:26,869 --> 00:08:25,280
spectacularly beautiful images but

228
00:08:28,869 --> 00:08:26,879
they're a little bit cloudy around what

229
00:08:31,029 --> 00:08:28,879
we need to see so that's why this

230
00:08:32,230 --> 00:08:31,039
telescope is going to be able to see so

231
00:08:34,149 --> 00:08:32,240
much more

232
00:08:36,389 --> 00:08:34,159
if you want to follow along and see us

233
00:08:38,630 --> 00:08:36,399
building the james webb space telescope

234
00:08:41,589 --> 00:08:38,640
go online to our webpage

235
00:08:43,670 --> 00:08:41,599
at nasa.gov james webb space telescope

236
00:08:45,030 --> 00:08:43,680
and you can check out our webcam and see

237
00:08:49,350 --> 00:08:45,040
the engineers putting the pieces

238
00:08:53,269 --> 00:08:52,070

an avalanche of discoveries that's very

239
00:08:55,590 --> 00:08:53,279
exciting

240
00:08:57,190 --> 00:08:55,600
mrs arnold's class from george day

241
00:08:59,430 --> 00:08:57,200
middle school in new jersey wants to

242
00:09:02,550 --> 00:08:59,440
know when you're expecting to launch the

243
00:09:05,350 --> 00:09:02,560
james webb telescope so great question

244
00:09:06,949 --> 00:09:05,360
we're working hard industriously here at

245
00:09:09,030 --> 00:09:06,959
goddard and across nasa and with

246
00:09:10,710 --> 00:09:09,040
partners abroad to build this telescope

247
00:09:13,910 --> 00:09:10,720
to have it ready for launch in the

248
00:09:16,389 --> 00:09:13,920
middle to middle to fall of 2018. that's

249
00:09:18,070 --> 00:09:16,399
about three years now web is a really

250
00:09:19,670 --> 00:09:18,080
big telescope it has a lot of careful

251
00:09:21,190 --> 00:09:19,680
testing to do the job that you just

252
00:09:23,750 --> 00:09:21,200
heard about and it's going to take at

253
00:09:24,949 --> 00:09:23,760
least three months to get on station for

254
00:09:26,470 --> 00:09:24,959
it to begin

255
00:09:29,750 --> 00:09:26,480
deploying itself and getting ready for

256
00:09:31,350 --> 00:09:29,760
making these spectacular observations

257
00:09:32,790 --> 00:09:31,360
so when we were here last week we

258
00:09:35,190 --> 00:09:32,800
learned about a lot of missions that are

259
00:09:37,430 --> 00:09:35,200
going on here at goddard and one of the

260
00:09:39,030 --> 00:09:37,440
projects that we heard about was sam can

261
00:09:41,110 --> 00:09:39,040
you tell us what sam stands for and a

262
00:09:44,710 --> 00:09:41,120
little bit more about that project sure

263
00:09:46,870 --> 00:09:44,720

so sam which is sample analysis at mars

264
00:09:49,430 --> 00:09:46,880
is one of the keystone experiments on

265
00:09:53,190 --> 00:09:49,440
our mars science laboratory curiosity

266
00:09:55,350 --> 00:09:53,200
rover and curiosity is a car-sized

267
00:09:57,990 --> 00:09:55,360
roving laboratory an observatory on a

268
00:10:00,310 --> 00:09:58,000
planetary surface crawling across mars

269
00:10:02,790 --> 00:10:00,320
within the gale crater to basically read

270
00:10:04,630 --> 00:10:02,800
the record books about how mars works

271
00:10:06,870 --> 00:10:04,640
how its past environments worked through

272
00:10:08,630 --> 00:10:06,880
the record of rocks the mars atmosphere

273
00:10:11,269 --> 00:10:08,640
and everything and we're excited that

274
00:10:14,470 --> 00:10:11,279
sam was developed here at goddard to be

275
00:10:16,150 --> 00:10:14,480
this keystone experiment

276
00:10:18,310 --> 00:10:16,160
when we were here last week we got to

277
00:10:21,030 --> 00:10:18,320
meet with the chief investigator for sam

278
00:10:23,590 --> 00:10:21,040
dr paul mahaffey let's learn more about

279
00:10:25,990 --> 00:10:23,600
this mission

280
00:10:28,949 --> 00:10:26,000
do you care if we're the only

281
00:10:31,110 --> 00:10:28,959
form of life in the universe or not or

282
00:10:33,350 --> 00:10:31,120
wouldn't you find it interesting to know

283
00:10:35,910 --> 00:10:33,360
that someplace else in our solar system

284
00:10:38,389 --> 00:10:35,920
maybe on the planet that's just a little

285
00:10:40,870 --> 00:10:38,399
bit further out from the sun than we are

286
00:10:43,509 --> 00:10:40,880
that life might have once existed my

287
00:10:45,910 --> 00:10:43,519
name is paul mahathi i'm a chief of the

288
00:10:47,509 --> 00:10:45,920

planetary environments lab here at nasa

289
00:10:48,470 --> 00:10:47,519
goddard space flight center in greenbelt

290
00:10:50,550 --> 00:10:48,480
maryland

291
00:10:53,509 --> 00:10:50,560
nearly every day on mars we're getting

292
00:10:56,230 --> 00:10:53,519
data back from the curiosity rover which

293
00:10:57,190 --> 00:10:56,240
landed more than two years ago on mars

294
00:10:59,670 --> 00:10:57,200
and

295
00:11:02,069 --> 00:10:59,680
our part of the experiment called sam

296
00:11:03,990 --> 00:11:02,079
sample analysis at mars

297
00:11:05,110 --> 00:11:04,000
sniffs the atmosphere it's a nose of the

298
00:11:06,389 --> 00:11:05,120
rover

299
00:11:09,430 --> 00:11:06,399
we either

300
00:11:11,269 --> 00:11:09,440
measure the atmosphere or we sniff gases

301
00:11:11,990 --> 00:11:11,279
that come off samples when we heat them

302
00:11:14,150 --> 00:11:12,000
up

303
00:11:15,829 --> 00:11:14,160
so every day on mars we're taking

304
00:11:18,389 --> 00:11:15,839
pictures with the camera

305
00:11:20,150 --> 00:11:18,399
we're exploring the rocks with

306
00:11:23,190 --> 00:11:20,160
instruments that are on the arm and

307
00:11:25,269 --> 00:11:23,200
every once in a while we put sample

308
00:11:27,829 --> 00:11:25,279
inside sam and we carry out these

309
00:11:29,990 --> 00:11:27,839
experiments we look at the data and we

310
00:11:32,470 --> 00:11:30,000
try and unravel the mysteries of what

311
00:11:34,710 --> 00:11:32,480
mars was like billions of years ago the

312
00:11:37,670 --> 00:11:34,720
big question that curiosity is trying to

313
00:11:39,829 --> 00:11:37,680

answer is there life on mars or was

314
00:11:43,190 --> 00:11:39,839
there life on mars we don't know the

315
00:11:45,350 --> 00:11:43,200
answer to that yet but we're sure making

316
00:11:47,430 --> 00:11:45,360
big steps in

317
00:11:49,430 --> 00:11:47,440
understanding how to go about solving

318
00:11:51,910 --> 00:11:49,440
that problem and

319
00:11:53,910 --> 00:11:51,920
one of these steps is understanding were

320
00:11:55,590 --> 00:11:53,920
there lakes on mars that lasted for long

321
00:11:58,470 --> 00:11:55,600
periods of time

322
00:12:00,710 --> 00:11:58,480
are there chemicals organic molecules

323
00:12:02,150 --> 00:12:00,720
that life makes on earth that we can

324
00:12:04,150 --> 00:12:02,160
find on mars

325
00:12:05,670 --> 00:12:04,160
are there chemicals in the atmosphere

326
00:12:07,590 --> 00:12:05,680
like methane

327
00:12:09,990 --> 00:12:07,600
that we find on earth that comes from

328
00:12:11,750 --> 00:12:10,000
life we're making big steps in answering

329
00:12:13,750 --> 00:12:11,760
all of those questions so we don't know

330
00:12:16,230 --> 00:12:13,760
the answer yet is there or was there

331
00:12:18,310 --> 00:12:16,240
life on mars but we're sure making great

332
00:12:20,870 --> 00:12:18,320
progress in getting to that point the

333
00:12:22,949 --> 00:12:20,880
rover moves very slowly it's about the

334
00:12:25,190 --> 00:12:22,959
size of the car we'd love to have it

335
00:12:27,750 --> 00:12:25,200
move as fast as a car does but it

336
00:12:30,710 --> 00:12:27,760
doesn't so it just moves a few hundred

337
00:12:32,550 --> 00:12:30,720
feet every day depends on how rocky the

338
00:12:34,150 --> 00:12:32,560

terrain is and whether you have a lot of

339
00:12:37,110 --> 00:12:34,160
sand or not but it moves very very

340
00:12:38,710 --> 00:12:37,120
slowly we really want to understand if

341
00:12:40,069 --> 00:12:38,720
there's methane in the atmosphere of

342
00:12:41,910 --> 00:12:40,079
mars or not

343
00:12:44,550 --> 00:12:41,920
methane on mars

344
00:12:45,829 --> 00:12:44,560
could come from life so that's really

345
00:12:48,389 --> 00:12:45,839
interesting

346
00:12:50,389 --> 00:12:48,399
if we find methane it means that we're

347
00:12:51,910 --> 00:12:50,399
hot on the trail of something we don't

348
00:12:53,829 --> 00:12:51,920
have any final answers yet where the

349
00:12:55,670 --> 00:12:53,839
methane came from but it's really

350
00:12:57,509 --> 00:12:55,680
exciting we have another mystery to

351
00:12:58,870 --> 00:12:57,519
solve we we looked and we looked for

352
00:13:01,030 --> 00:12:58,880
months and months and then all of a

353
00:13:03,110 --> 00:13:01,040
sudden we detected methane there was a

354
00:13:05,030 --> 00:13:03,120
methane spike in our data that lasted

355
00:13:07,350 --> 00:13:05,040
for a few weeks that was another big

356
00:13:09,990 --> 00:13:07,360
moment well it may seem like

357
00:13:13,030 --> 00:13:10,000
understanding more and more about modern

358
00:13:15,430 --> 00:13:13,040
and ancient mars doesn't impact our

359
00:13:18,230 --> 00:13:15,440
day-to-day going about what we do on

360
00:13:21,590 --> 00:13:18,240
earth it's part of our culture as part

361
00:13:22,550 --> 00:13:21,600
of the things that as a human race we

362
00:13:26,310 --> 00:13:22,560
want to

363
00:13:27,509 --> 00:13:26,320

ourselves more about our place in the

364
00:13:30,150 --> 00:13:27,519
universe

365
00:13:33,670 --> 00:13:30,160
i always found chemistry and mathematics

366
00:13:35,910 --> 00:13:33,680
very interesting those are really

367
00:13:38,310 --> 00:13:35,920
excellent things to

368
00:13:40,949 --> 00:13:38,320
be familiar with if you're if you're

369
00:13:42,069 --> 00:13:40,959
interested in a scientific or technical

370
00:13:44,470 --> 00:13:42,079
career

371
00:13:47,509 --> 00:13:44,480
but then once you start

372
00:13:50,150 --> 00:13:47,519
exploring the planets you understand how

373
00:13:52,790 --> 00:13:50,160
many different skills you have to bring

374
00:13:54,310 --> 00:13:52,800
to the table to do this job right

375
00:13:56,470 --> 00:13:54,320
you require people who are good at

376
00:13:58,629 --> 00:13:56,480
programming you require people who are

377
00:14:01,030 --> 00:13:58,639
good at mathematics you require people

378
00:14:02,949 --> 00:14:01,040
who are good at chemistry you even

379
00:14:05,110 --> 00:14:02,959
require people who

380
00:14:07,829 --> 00:14:05,120
aren't good at any of those things but

381
00:14:13,269 --> 00:14:07,839
they're good at communicating to other

382
00:14:16,310 --> 00:14:14,550
so he makes some really interesting

383
00:14:17,750 --> 00:14:16,320
points especially about developing skill

384
00:14:18,949 --> 00:14:17,760
sets so everyone should remember that

385
00:14:22,230 --> 00:14:18,959
right indeed

386
00:14:23,590 --> 00:14:22,240
so i've been told that the curiosity is

387
00:14:26,230 --> 00:14:23,600
one of the most complex instruments

388
00:14:28,790 --> 00:14:26,240

we've ever landed on another planet and

389
00:14:30,470 --> 00:14:28,800
certainly the mission is and sam is

390
00:14:31,910 --> 00:14:30,480
something that many students are

391
00:14:33,189 --> 00:14:31,920
interested in as a matter of fact we've

392
00:14:36,310 --> 00:14:33,199
got jessie

393
00:14:38,069 --> 00:14:36,320
damien nivea and angel from cleveland

394
00:14:40,069 --> 00:14:38,079
school in pennsylvania and they want to

395
00:14:41,189 --> 00:14:40,079
know how long did it take for you to

396
00:14:42,710 --> 00:14:41,199
build sam

397
00:14:45,030 --> 00:14:42,720
so that's a great question these

398
00:14:47,189 --> 00:14:45,040
instruments are unbelievable sam is

399
00:14:50,069 --> 00:14:47,199
actually three instruments in one it

400
00:14:53,269 --> 00:14:50,079
took us around six years to design

401
00:14:55,269 --> 00:14:53,279
build test evaluate calibrate and make

402
00:14:56,629 --> 00:14:55,279
sure it's going to work in deep space to

403
00:15:00,230 --> 00:14:56,639
get it to the point where it could go to

404
00:15:02,629 --> 00:15:00,240
mars and today 970 odd days of exploring

405
00:15:04,710 --> 00:15:02,639
mars sam's working better than ever it's

406
00:15:07,269 --> 00:15:04,720
still exploring so these things take

407
00:15:08,629 --> 00:15:07,279
time but it's worth it

408
00:15:10,230 --> 00:15:08,639
can you tell us a little bit more about

409
00:15:13,110 --> 00:15:10,240
how you communicate with sam and

410
00:15:15,189 --> 00:15:13,120
curiosity so curiosity is on mars and

411
00:15:17,670 --> 00:15:15,199
today that's on the order of 100 million

412
00:15:19,269 --> 00:15:17,680
miles from earth so basically we have a

413
00:15:21,189 --> 00:15:19,279

routine uh

414
00:15:23,590 --> 00:15:21,199
every day around 10 o'clock local mars

415
00:15:25,350 --> 00:15:23,600
surface time we communicate through

416
00:15:27,750 --> 00:15:25,360
earth to earth either directly or

417
00:15:29,350 --> 00:15:27,760
through a relay satellite in this case

418
00:15:31,590 --> 00:15:29,360
either the mars reconnaissance orbit or

419
00:15:33,269 --> 00:15:31,600
mars odyssey this allows us to send

420
00:15:35,990 --> 00:15:33,279
signals up to mars orbit and back to

421
00:15:38,470 --> 00:15:36,000
earth here on earth of course sometimes

422
00:15:40,389 --> 00:15:38,480
the clocks align and so 10 o'clock on

423
00:15:43,189 --> 00:15:40,399
mars is 10 o'clock in the morning in

424
00:15:44,710 --> 00:15:43,199
california or in in maryland but

425
00:15:47,189 --> 00:15:44,720
the day the

426
00:15:48,790 --> 00:15:47,199
time of day the length of day on mars is

427
00:15:51,590 --> 00:15:48,800
a little bit longer than on earth by

428
00:15:53,430 --> 00:15:51,600
about 37 minutes so as we start working

429
00:15:56,150 --> 00:15:53,440
on mars time

430
00:15:57,670 --> 00:15:56,160
the day extends and extends so

431
00:15:59,749 --> 00:15:57,680
our scientists and engineers who work on

432
00:16:01,749 --> 00:15:59,759
mars may be all working at ten o'clock

433
00:16:03,430 --> 00:16:01,759
one morning and three months later three

434
00:16:05,910 --> 00:16:03,440
o'clock in the afternoon three months

435
00:16:08,949 --> 00:16:05,920
later six o'clock at night so we get got

436
00:16:10,629 --> 00:16:08,959
to get to know mars on mars time which

437
00:16:12,470 --> 00:16:10,639
isn't quite like earth

438
00:16:14,550 --> 00:16:12,480

mars time is really interesting can you

439
00:16:16,310 --> 00:16:14,560
explain just really quickly why mars

440
00:16:18,790 --> 00:16:16,320
time is different than earth time

441
00:16:20,629 --> 00:16:18,800
because earth rotates in 24 hours we're

442
00:16:23,269 --> 00:16:20,639
very used to that the ebb and flow

443
00:16:25,509 --> 00:16:23,279
sunset sunrise on mars that time for

444
00:16:28,389 --> 00:16:25,519
mars to rotate around its its rotational

445
00:16:30,790 --> 00:16:28,399
axis is just 37 minutes longer and that

446
00:16:33,110 --> 00:16:30,800
little bit of time over months makes a

447
00:16:34,629 --> 00:16:33,120
big difference in how you live and work

448
00:16:37,430 --> 00:16:34,639
so it doesn't line up perfectly not

449
00:16:39,030 --> 00:16:37,440
exactly so mars is something that lots

450
00:16:41,590 --> 00:16:39,040
of people are interested in and we've

451
00:16:42,790 --> 00:16:41,600
gotten lots of questions from students

452
00:16:44,389 --> 00:16:42,800
and

453
00:16:45,990 --> 00:16:44,399
many of them want to know when will they

454
00:16:46,790 --> 00:16:46,000
be able to go to mars

455
00:16:48,790 --> 00:16:46,800
so

456
00:16:51,269 --> 00:16:48,800
students and everyone we're on mars

457
00:16:53,350 --> 00:16:51,279
today it's spectacular our robots are

458
00:16:55,509 --> 00:16:53,360
exploring the world as if we were there

459
00:16:57,910 --> 00:16:55,519
somewhat long time delay but still it's

460
00:16:59,829 --> 00:16:57,920
amazing we have orbiters there and so

461
00:17:01,749 --> 00:16:59,839
our presence is opening the martian

462
00:17:03,430 --> 00:17:01,759
frontier someday of course we want to go

463
00:17:06,470 --> 00:17:03,440

ourselves and we want to extend

464
00:17:08,630 --> 00:17:06,480
ourselves to being there and while some

465
00:17:11,189 --> 00:17:08,640
of us feel like we're there now

466
00:17:13,909 --> 00:17:11,199
that prospect is is really something we

467
00:17:15,590 --> 00:17:13,919
can imagine and in the next 20 30 years

468
00:17:17,029 --> 00:17:15,600
thanks to programs we have at nasa and

469
00:17:20,150 --> 00:17:17,039
our partners

470
00:17:21,909 --> 00:17:20,160
in europe in asia australia canada that

471
00:17:23,750 --> 00:17:21,919
possibility could become real as we

472
00:17:26,230 --> 00:17:23,760
learn from our robots the martian

473
00:17:29,110 --> 00:17:26,240
frontier could open to possibilities for

474
00:17:31,350 --> 00:17:29,120
us going ourselves to become explorers

475
00:17:33,750 --> 00:17:31,360
on site on mars

476
00:17:35,590 --> 00:17:33,760
thank you that's fascinating

477
00:17:37,830 --> 00:17:35,600
so one of the other scientists we got to

478
00:17:39,909 --> 00:17:37,840
meet last week was dr james dwerkin who

479
00:17:42,789 --> 00:17:39,919
is working on a project called oscillo

480
00:17:44,870 --> 00:17:42,799
osiris-rex sorry let's find out more

481
00:17:47,190 --> 00:17:44,880
about osiris-rex

482
00:17:49,190 --> 00:17:47,200
my name is jason dworkin i'm the chief

483
00:17:51,590 --> 00:17:49,200
of astrochemistry nasa goddard i'm also

484
00:18:02,870 --> 00:17:51,600
the project scientist for osiris-rex

485
00:18:07,190 --> 00:18:05,270
my name is jason dworkin i'm the chief

486
00:18:09,669 --> 00:18:07,200
of astrochemistry nasa goddard i'm also

487
00:18:12,310 --> 00:18:09,679
the project scientist for osiris-rex

488
00:18:14,630 --> 00:18:12,320

assassirex is a nasa mission to go to

489
00:18:16,390 --> 00:18:14,640
asteroid bennu to give us information

490
00:18:18,390 --> 00:18:16,400
about the early solar system

491
00:18:20,549 --> 00:18:18,400
so this is asteroid bennu the asteroid

492
00:18:22,470 --> 00:18:20,559
bennu is about five football fields

493
00:18:24,470 --> 00:18:22,480
across roughly spherical so five

494
00:18:26,310 --> 00:18:24,480
football fields in all directions and

495
00:18:28,150 --> 00:18:26,320
this artistic spacecraft is about the

496
00:18:30,870 --> 00:18:28,160
size of a car it takes about two years

497
00:18:32,630 --> 00:18:30,880
to get the asteroid after launch in 2016

498
00:18:35,430 --> 00:18:32,640
then we orbit the asteroid for about a

499
00:18:37,590 --> 00:18:35,440
year and collect a sample we can collect

500
00:18:40,070 --> 00:18:37,600
up to three times if we need to and then

501
00:18:42,950 --> 00:18:40,080
we return to the earth in 2023 this is a

502
00:18:44,150 --> 00:18:42,960
radar map of bennu is a rapid prototype

503
00:18:46,789 --> 00:18:44,160
object

504
00:18:48,390 --> 00:18:46,799
we will orbit the the asteroids about

505
00:18:50,630 --> 00:18:48,400
half kilometer across

506
00:18:52,789 --> 00:18:50,640
and on this scale the spacecraft is

507
00:18:55,510 --> 00:18:52,799
about the size of a head of a pin

508
00:18:56,950 --> 00:18:55,520
and we will descend to touch the

509
00:18:59,110 --> 00:18:56,960
asteroid

510
00:19:00,630 --> 00:18:59,120
osiris-rex spacecraft has a three meter

511
00:19:02,630 --> 00:19:00,640
long arm at the end of it has something

512
00:19:04,230 --> 00:19:02,640
like like an old car air filter the

513
00:19:06,310 --> 00:19:04,240

spacecraft descends to touch the

514
00:19:08,710 --> 00:19:06,320
asteroid on the end of this pogo stick

515
00:19:11,270 --> 00:19:08,720
blows a jet of nitrogen gas

516
00:19:13,190 --> 00:19:11,280
that fluidizes the regulators

517
00:19:16,230 --> 00:19:13,200
mixes it up this gas

518
00:19:18,390 --> 00:19:16,240
it gets trapped in the air filter

519
00:19:20,870 --> 00:19:18,400
collecting at least 60 grams much two

520
00:19:22,549 --> 00:19:20,880
kilograms of pristine rocks from the

521
00:19:24,150 --> 00:19:22,559
asteroid to bring back to earth it's

522
00:19:27,029 --> 00:19:24,160
important to get a sample from bennu

523
00:19:28,789 --> 00:19:27,039
because this is a primitive object it

524
00:19:30,630 --> 00:19:28,799
records the formation of the solar

525
00:19:32,310 --> 00:19:30,640
system rocks that are older than the

526
00:19:34,310 --> 00:19:32,320
earth that we can bring back and

527
00:19:37,190 --> 00:19:34,320
understand the chemistry of the ancient

528
00:19:39,029 --> 00:19:37,200
solar system the origins of life on

529
00:19:41,110 --> 00:19:39,039
earth or perhaps elsewhere in the solar

530
00:19:43,270 --> 00:19:41,120
system the sample we bring back from

531
00:19:44,150 --> 00:19:43,280
bennu will rewrite the textbooks

532
00:19:45,510 --> 00:19:44,160
and

533
00:19:47,110 --> 00:19:45,520
when you read these textbooks in the

534
00:19:48,630 --> 00:19:47,120
future you'll be able to ask new

535
00:19:50,710 --> 00:19:48,640
questions

536
00:19:52,549 --> 00:19:50,720
look at the sample yourself

537
00:19:54,549 --> 00:19:52,559
and answer them

538
00:19:55,590 --> 00:19:54,559

maybe someone watching this video will

539
00:19:58,150 --> 00:19:55,600
grow up

540
00:19:59,430 --> 00:19:58,160
become a planetary scientist and study

541
00:20:01,590 --> 00:19:59,440
the samples

542
00:20:03,270 --> 00:20:01,600
somewhere on earth and using the best

543
00:20:05,190 --> 00:20:03,280
techniques that have maybe not been

544
00:20:07,669 --> 00:20:05,200
invented yet asking questions we're not

545
00:20:11,110 --> 00:20:07,679
smart enough to ask right now about the

546
00:20:14,390 --> 00:20:12,549
well one thing i bet that you're

547
00:20:16,630 --> 00:20:14,400
wondering about is how we came to name

548
00:20:18,870 --> 00:20:16,640
this asteroid this third of a mile rock

549
00:20:20,470 --> 00:20:18,880
that you just heard about and so we were

550
00:20:23,669 --> 00:20:20,480
very lucky to work with the planetary

551
00:20:26,390 --> 00:20:23,679
society um and a young student from

552
00:20:28,390 --> 00:20:26,400
north carolina mike puzio was

553
00:20:30,149 --> 00:20:28,400
was actually the winner in the naming

554
00:20:31,669 --> 00:20:30,159
competition for this very important

555
00:20:33,430 --> 00:20:31,679
object

556
00:20:35,590 --> 00:20:33,440
so let me just tell you that what's

557
00:20:38,470 --> 00:20:35,600
really interesting is he used the fact

558
00:20:40,230 --> 00:20:38,480
that the mission osiris-rex the way it

559
00:20:43,590 --> 00:20:40,240
encounters the asteroid and will sample

560
00:20:46,549 --> 00:20:43,600
it reminded him of drawings of a famous

561
00:20:49,190 --> 00:20:46,559
egyptian god named bennu so we're naming

562
00:20:52,470 --> 00:20:49,200
the the asteroid and our mission to that

563
00:20:55,590 --> 00:20:52,480

asteroid for the the god from egyptian

564
00:20:57,750 --> 00:20:55,600
mythology that best depicts it because i

565
00:21:00,470 --> 00:20:57,760
understand that bennu had a really long

566
00:21:01,430 --> 00:21:00,480
arm right and so because

567
00:21:02,390 --> 00:21:01,440
the

568
00:21:04,789 --> 00:21:02,400
project

569
00:21:05,830 --> 00:21:04,799
has a really long arm so that's where he

570
00:21:07,270 --> 00:21:05,840
came up with the name and he was only

571
00:21:10,390 --> 00:21:07,280
nine years old nine years old which is

572
00:21:12,149 --> 00:21:10,400
kind of fast cool yeah so why

573
00:21:15,110 --> 00:21:12,159
was bennu

574
00:21:17,190 --> 00:21:15,120
um even chosen for this mission

575
00:21:18,950 --> 00:21:17,200
so there are a lot of asteroids folks

576
00:21:21,029 --> 00:21:18,960
they're almost countably infinite in our

577
00:21:23,350 --> 00:21:21,039
solar system and these small bodies come

578
00:21:25,430 --> 00:21:23,360
in lots of shapes and sizes the trick is

579
00:21:27,510 --> 00:21:25,440
to find one you can get to that is in

580
00:21:30,149 --> 00:21:27,520
the right place so our space flight

581
00:21:32,230 --> 00:21:30,159
engineers can get us there and also made

582
00:21:33,990 --> 00:21:32,240
of the right stuff so right place right

583
00:21:35,830 --> 00:21:34,000
stuff led to the selection of bennu

584
00:21:37,430 --> 00:21:35,840
there were only a few choices and then

585
00:21:39,350 --> 00:21:37,440
it was about a third of a mile across as

586
00:21:40,870 --> 00:21:39,360
you heard and it's made of these very

587
00:21:43,029 --> 00:21:40,880
primitive building blocks of the early

588
00:21:45,110 --> 00:21:43,039

solar system we don't have samples of

589
00:21:47,190 --> 00:21:45,120
that kind of stuff here on earth so

590
00:21:48,789 --> 00:21:47,200
getting there and sampling it is

591
00:21:50,390 --> 00:21:48,799
critical to understanding even the

592
00:21:53,190 --> 00:21:50,400
origins of how our planet put itself

593
00:21:54,950 --> 00:21:53,200
together to become habitable and finally

594
00:21:56,789 --> 00:21:54,960
bennu is of a class of objects in our

595
00:21:59,110 --> 00:21:56,799
solar system that are potentially

596
00:22:01,590 --> 00:21:59,120
hazardous if their orbits are perturbed

597
00:22:03,669 --> 00:22:01,600
as happens over long time scales of

598
00:22:05,190 --> 00:22:03,679
millions of years they can be perturbed

599
00:22:06,230 --> 00:22:05,200
into things that could collide with the

600
00:22:08,230 --> 00:22:06,240
earth

601
00:22:10,470 --> 00:22:08,240
but not tomorrow not tomorrow we got

602
00:22:12,149 --> 00:22:10,480
plenty of time it's all good that's good

603
00:22:13,350 --> 00:22:12,159
so people are fascinated with asteroids

604
00:22:14,710 --> 00:22:13,360
and as a matter of fact we have a

605
00:22:16,870 --> 00:22:14,720
student named sophie who's from

606
00:22:19,669 --> 00:22:16,880
switzerland point middle school in

607
00:22:21,750 --> 00:22:19,679
florida and sophie uh is very interested

608
00:22:24,070 --> 00:22:21,760
in asteroids and would like to know

609
00:22:26,230 --> 00:22:24,080
when do you think or will it be possible

610
00:22:27,190 --> 00:22:26,240
to land on an asteroid well great

611
00:22:29,029 --> 00:22:27,200
question

612
00:22:30,870 --> 00:22:29,039
well first of course

613
00:22:32,789 --> 00:22:30,880

cyrus rex will give us practice with a

614
00:22:34,630 --> 00:22:32,799
robot encountering one of these objects

615
00:22:36,470 --> 00:22:34,640
and these objects are small a few

616
00:22:38,950 --> 00:22:36,480
football fields across a couple of

617
00:22:40,310 --> 00:22:38,960
hockey rinks if you like that scale and

618
00:22:42,149 --> 00:22:40,320
they're so small they don't have a lot

619
00:22:45,270 --> 00:22:42,159
of mass and thus they don't have a lot

620
00:22:47,110 --> 00:22:45,280
of gravitational attractive energy to to

621
00:22:48,630 --> 00:22:47,120
actually allow them to feel as if you

622
00:22:50,149 --> 00:22:48,640
were landing in fact when we encounter

623
00:22:51,990 --> 00:22:50,159
these objects

624
00:22:54,230 --> 00:22:52,000
we would essentially be docking with

625
00:22:55,990 --> 00:22:54,240
them and would have to in fact be

626
00:22:57,669 --> 00:22:56,000
tethered if you went to one yourself

627
00:23:00,710 --> 00:22:57,679
otherwise if you took a step off the

628
00:23:02,310 --> 00:23:00,720
asteroid you would in fact escape so

629
00:23:03,909 --> 00:23:02,320
today we're going to the asteroid with

630
00:23:07,510 --> 00:23:03,919
robots we would love to have an

631
00:23:09,350 --> 00:23:07,520
opportunity um in the 20s 10 15 20 years

632
00:23:11,350 --> 00:23:09,360
from now to send human beings either

633
00:23:13,510 --> 00:23:11,360
close to asteroids close to pieces of

634
00:23:15,510 --> 00:23:13,520
asteroids that that have been returned

635
00:23:17,110 --> 00:23:15,520
and relocated closer to earth so we can

636
00:23:18,470 --> 00:23:17,120
better get to know this important class

637
00:23:20,230 --> 00:23:18,480
of object

638
00:23:22,230 --> 00:23:20,240

so essentially what you're saying is the

639
00:23:25,270 --> 00:23:22,240
asteroid doesn't have enough stuff to

640
00:23:26,950 --> 00:23:25,280
hold on to us right okay so here's

641
00:23:28,390 --> 00:23:26,960
another question for you i've noticed in

642
00:23:30,470 --> 00:23:28,400
a lot of the video clips and some of the

643
00:23:31,830 --> 00:23:30,480
things you've mentioned that

644
00:23:33,190 --> 00:23:31,840
a lot of the measurements that you're

645
00:23:35,110 --> 00:23:33,200
taking and talking about are in the

646
00:23:36,950 --> 00:23:35,120
metric system can you explain why you

647
00:23:39,750 --> 00:23:36,960
use the metric system well great

648
00:23:41,909 --> 00:23:39,760
question in fact the language uh the

649
00:23:43,350 --> 00:23:41,919
language we speak in engineering math

650
00:23:45,669 --> 00:23:43,360
and science that allows us to

651
00:23:47,909 --> 00:23:45,679
communicate internationally across all

652
00:23:49,750 --> 00:23:47,919
kinds of of people women and men to

653
00:23:51,830 --> 00:23:49,760
build these missions to explore this

654
00:23:53,990 --> 00:23:51,840
universe is the language of the metric

655
00:23:55,510 --> 00:23:54,000
system it's a common it's a common

656
00:23:57,830 --> 00:23:55,520
language and we need it for our

657
00:23:59,750 --> 00:23:57,840
measurements so we all build to the same

658
00:24:01,350 --> 00:23:59,760
standards and these things all work and

659
00:24:02,950 --> 00:24:01,360
so it's very important that we

660
00:24:05,190 --> 00:24:02,960
communicate in ways that we all

661
00:24:06,230 --> 00:24:05,200
understand even with other communication

662
00:24:07,669 --> 00:24:06,240
barriers

663
00:24:08,950 --> 00:24:07,679

so even if i can't understand what

664
00:24:11,830 --> 00:24:08,960
you're saying to me i can understand

665
00:24:12,549 --> 00:24:11,840
your math exactly okay that makes sense

666
00:24:14,390 --> 00:24:12,559
so

667
00:24:15,669 --> 00:24:14,400
another project that we've gotten a lot

668
00:24:17,909 --> 00:24:15,679
of questions about and i think you can

669
00:24:19,110 --> 00:24:17,919
imagine why is the new horizons project

670
00:24:21,750 --> 00:24:19,120
so can you tell us a little bit about

671
00:24:24,149 --> 00:24:21,760
new horizons so new horizons is an

672
00:24:25,830 --> 00:24:24,159
unbelievable mission of discovery to go

673
00:24:27,990 --> 00:24:25,840
to the farthest reaches of the known

674
00:24:31,190 --> 00:24:28,000
solar system new horizons will go to the

675
00:24:33,830 --> 00:24:31,200
pluto system about 40 times as far from

676
00:24:35,909 --> 00:24:33,840
the sun as the earth is so this is way

677
00:24:38,789 --> 00:24:35,919
out and it's been traveling for nine

678
00:24:41,190 --> 00:24:38,799
years just to get close to pluto so it's

679
00:24:43,269 --> 00:24:41,200
a mission of discovery to chronicle to

680
00:24:46,149 --> 00:24:43,279
inventory a part of the solar system we

681
00:24:48,390 --> 00:24:46,159
really don't understand very well

682
00:24:50,149 --> 00:24:48,400
so students are fascinated they're

683
00:24:52,390 --> 00:24:50,159
fascinated with pluto they're fascinated

684
00:24:53,990 --> 00:24:52,400
with the far reaches of our you know

685
00:24:56,549 --> 00:24:54,000
planetary system

686
00:24:59,430 --> 00:24:56,559
in fact we've got a third grade class

687
00:25:02,549 --> 00:24:59,440
at peter's k3 elementary in california

688
00:25:03,990 --> 00:25:02,559

and same question from skyler and ava

689
00:25:05,990 --> 00:25:04,000
from moffatt elementary also in

690
00:25:08,070 --> 00:25:06,000
california and they all want to know

691
00:25:09,830 --> 00:25:08,080
what do we expect to see when new

692
00:25:11,830 --> 00:25:09,840
horizons reaches pluto what do we expect

693
00:25:15,590 --> 00:25:11,840
to get back from there so when we get to

694
00:25:17,990 --> 00:25:15,600
pluto that's july this summer 2015.

695
00:25:19,590 --> 00:25:18,000
we really have only estimates

696
00:25:21,990 --> 00:25:19,600
guesstimates of what we'll see it's

697
00:25:23,990 --> 00:25:22,000
going to be spectacular in fact our

698
00:25:26,310 --> 00:25:24,000
imagination probably does not prepare us

699
00:25:28,549 --> 00:25:26,320
adequately for the new science questions

700
00:25:31,029 --> 00:25:28,559
that we will uncover as we image and

701
00:25:33,990 --> 00:25:31,039
explore the chemistry the materials

702
00:25:36,549 --> 00:25:34,000
around pluto and its and its moons so

703
00:25:39,110 --> 00:25:36,559
we're in total discovery mode as we get

704
00:25:41,029 --> 00:25:39,120
to this new class of object so far out

705
00:25:43,350 --> 00:25:41,039
that only our telescopes only produce a

706
00:25:45,110 --> 00:25:43,360
few pixels a few picture elements across

707
00:25:46,710 --> 00:25:45,120
them as we look at them today right and

708
00:25:48,230 --> 00:25:46,720
you called it a new class of object and

709
00:25:51,830 --> 00:25:48,240
that brings up a question that we get a

710
00:25:54,190 --> 00:25:51,840
lot and that is why was pluto changed to

711
00:25:56,789 --> 00:25:54,200
a dwarf planet so astronomers

712
00:25:59,510 --> 00:25:56,799
astrophysicists uh classify things on

713
00:26:02,070 --> 00:25:59,520

the basis of their size their position

714
00:26:05,269 --> 00:26:02,080
how they orbit our planets are our

715
00:26:07,029 --> 00:26:05,279
parents uh star the sun and so after

716
00:26:09,510 --> 00:26:07,039
lots of years of thought it goes back

717
00:26:11,750 --> 00:26:09,520
literally decades the astronomers feel

718
00:26:14,390 --> 00:26:11,760
that there is a class of objects that

719
00:26:16,149 --> 00:26:14,400
orbit the sun that are small but not as

720
00:26:18,870 --> 00:26:16,159
big as the primary planets in our solar

721
00:26:21,430 --> 00:26:18,880
system the eight biggies mercury venus

722
00:26:23,430 --> 00:26:21,440
earth mars jupiter etc and so they've

723
00:26:25,190 --> 00:26:23,440
classified them as dwarf planets they're

724
00:26:27,510 --> 00:26:25,200
just a little smaller and there's more

725
00:26:29,350 --> 00:26:27,520
than just one of those pluto being the

726
00:26:31,190 --> 00:26:29,360
first one named in fact we have a one

727
00:26:33,750 --> 00:26:31,200
word we're exploring right now known as

728
00:26:35,909 --> 00:26:33,760
ceres it's a dwarf planet in the

729
00:26:38,149 --> 00:26:35,919
asteroid belt between mars and jupiter

730
00:26:40,470 --> 00:26:38,159
fascinating object our dawn mission is

731
00:26:42,549 --> 00:26:40,480
exploring it as we speak so pluto's not

732
00:26:44,870 --> 00:26:42,559
alone not alone she's happy that's good

733
00:26:47,029 --> 00:26:44,880
to know i know i for one am very anxious

734
00:26:50,149 --> 00:26:47,039
to see what we see in july and find out

735
00:26:51,909 --> 00:26:50,159
more about the dwarf planet pluto

736
00:26:53,669 --> 00:26:51,919
so jim we have time for one more

737
00:26:55,830 --> 00:26:53,679
question and when i tell you we got

738
00:26:58,230 --> 00:26:55,840

thousands of questions we really did but

739
00:27:00,870 --> 00:26:58,240
there were many questions along this

740
00:27:03,430 --> 00:27:00,880
topic and so i have to ask you

741
00:27:05,510 --> 00:27:03,440
what does food taste like in space ah

742
00:27:07,350 --> 00:27:05,520
well first you know full disclosure i

743
00:27:09,430 --> 00:27:07,360
have not flown in space instruments that

744
00:27:11,190 --> 00:27:09,440
i've worked with have so but my friends

745
00:27:13,029 --> 00:27:11,200
that have flown including colleagues

746
00:27:14,710 --> 00:27:13,039
that have fixed hubble three times one

747
00:27:16,390 --> 00:27:14,720
of the first women in space they

748
00:27:18,230 --> 00:27:16,400
basically tell me that food and space

749
00:27:20,310 --> 00:27:18,240
tastes a lot like camping food so if you

750
00:27:22,870 --> 00:27:20,320
like camping and you want to go to space

751
00:27:24,710 --> 00:27:22,880
that's the food sensory experience you'd

752
00:27:26,549 --> 00:27:24,720
have and perhaps we could say probably

753
00:27:27,430 --> 00:27:26,559
tastes a lot like chicken

754
00:27:29,350 --> 00:27:27,440
okay

755
00:27:31,190 --> 00:27:29,360
so if you happen to be camping and

756
00:27:32,789 --> 00:27:31,200
you're eating chicken you can imagine

757
00:27:34,950 --> 00:27:32,799
that you are an astronaut in space and

758
00:27:36,789 --> 00:27:34,960
that's what your food will taste like

759
00:27:38,390 --> 00:27:36,799
well thank you dr garvin for visiting

760
00:27:40,549 --> 00:27:38,400
with us today thank you so much for

761
00:27:42,630 --> 00:27:40,559
sharing all of your great information we

762
00:27:43,909 --> 00:27:42,640
also want to thank the nasa engineers

763
00:27:45,510 --> 00:27:43,919

and scientists who've shared their

764
00:27:47,909 --> 00:27:45,520
projects with us today it was

765
00:27:49,669 --> 00:27:47,919
fascinating information you can keep

766
00:27:51,510 --> 00:27:49,679
track of the missions that are going on

767
00:27:54,789 --> 00:27:51,520
here at goddard and in nasa in general

768
00:27:57,350 --> 00:27:54,799
at their website nasa.gov and you can

769
00:27:59,909 --> 00:27:57,360
also see an archive of this event at

770
00:28:01,510 --> 00:27:59,919
discoveryeducation.com

771
00:28:03,990 --> 00:28:01,520
space day

772
00:28:07,190 --> 00:28:04,000
before we go i have one more thing to

773
00:28:09,269 --> 00:28:07,200
bring up jim and that is it is goddard's

774
00:28:12,149 --> 00:28:09,279
birthday so here's a little cupcake for

775
00:28:14,389 --> 00:28:12,159
you and we want to say happy birthday if

776
00:28:17,350 --> 00:28:14,399
you don't know goddard was established

777
00:28:19,909 --> 00:28:17,360
on may 1st 1959 so happy birthday

778
00:28:22,310 --> 00:28:19,919
goddard thank you so much for joining us

779
00:28:26,549 --> 00:28:22,320
today we hope that you enjoyed what we