
South Australia
Credit: JAXA

1
00:00:35,670 --> 00:00:33,030
good afternoon and welcome to the

2
00:00:37,990 --> 00:00:35,680
osiris-rex mission science briefing

3
00:00:40,389 --> 00:00:38,000
osiris-rex stands for origen's spectral

4
00:00:42,709 --> 00:00:40,399
interpretation resource identification

5
00:00:45,430 --> 00:00:42,719
security regulative explorer and it's

6
00:00:47,430 --> 00:00:45,440
nasa's first sample asteroid return

7
00:00:49,590 --> 00:00:47,440
mission

8
00:00:51,910 --> 00:00:49,600
and we'll start off with

9
00:00:53,910 --> 00:00:51,920
christina richie from the osiris-rex

10
00:00:57,189 --> 00:00:53,920
deputy program scientist at nasa

11
00:00:59,430 --> 00:00:57,199
headquarters in washington

12
00:01:01,270 --> 00:00:59,440
jason dworkin the osiris-rex project

13
00:01:04,469 --> 00:01:01,280

scientist at nasa's goddard space flight

14
00:01:05,590 --> 00:01:04,479
center in greenbelt maryland

15
00:01:08,710 --> 00:01:05,600
daniela

16
00:01:10,550 --> 00:01:08,720
della justina the osiris-rex lead image

17
00:01:12,789 --> 00:01:10,560
processing scientist at the university

18
00:01:14,710 --> 00:01:12,799
of arizona in tucson

19
00:01:17,350 --> 00:01:14,720
and we'll begin with christina thank you

20
00:01:19,190 --> 00:01:17,360
nancy so in the mission briefing before

21
00:01:21,830 --> 00:01:19,200
this you heard about the launch vehicle

22
00:01:23,910 --> 00:01:21,840
the spacecraft the mission objectives

23
00:01:25,429 --> 00:01:23,920
you even got to hear about the weather

24
00:01:27,910 --> 00:01:25,439
so here what we're going to be talking

25
00:01:29,429 --> 00:01:27,920
about is the science so i'm going to

26
00:01:32,230 --> 00:01:29,439
start off with talking about why we

27
00:01:33,830 --> 00:01:32,240
chose bennu as the target asteroid jason

28
00:01:35,910 --> 00:01:33,840
is going to talk about the sample and

29
00:01:37,990 --> 00:01:35,920
the analysis that will be done and danny

30
00:01:39,590 --> 00:01:38,000
is going to talk to us about the mapping

31
00:01:41,270 --> 00:01:39,600
that's going to occur

32
00:01:43,350 --> 00:01:41,280
so let's go ahead and begin with talking

33
00:01:45,190 --> 00:01:43,360
about why bennu so

34
00:01:46,870 --> 00:01:45,200
the ultimate goal of the osiris-rex

35
00:01:49,030 --> 00:01:46,880
mission is to collect a sample from an

36
00:01:51,270 --> 00:01:49,040
asteroid and bring it back to earth

37
00:01:52,710 --> 00:01:51,280
but why was bennu chosen for this

38
00:01:54,789 --> 00:01:52,720

exciting endeavor

39
00:01:56,550 --> 00:01:54,799
well the science team selected bennu

40
00:01:58,389 --> 00:01:56,560
after carefully taking into account

41
00:02:00,870 --> 00:01:58,399
three critical factors

42
00:02:03,109 --> 00:02:00,880
the accessibility of the asteroid

43
00:02:05,510 --> 00:02:03,119
the size such that it enables proximity

44
00:02:07,429 --> 00:02:05,520
operations and sample collection

45
00:02:08,949 --> 00:02:07,439
and the composition of that asteroid so

46
00:02:10,550 --> 00:02:08,959
let's get into each one of these

47
00:02:12,309 --> 00:02:10,560
individually and we'll start off with

48
00:02:13,830 --> 00:02:12,319
accessibility go ahead and start my

49
00:02:15,589 --> 00:02:13,840
first graphic

50
00:02:17,910 --> 00:02:15,599
so we need an asteroid target that a

51
00:02:20,070 --> 00:02:17,920
spacecraft could fly to and then return

52
00:02:21,510 --> 00:02:20,080
to earth within a few years time

53
00:02:23,830 --> 00:02:21,520
the closest asteroids to earth are

54
00:02:26,869 --> 00:02:23,840
called near-earth objects and they come

55
00:02:28,150 --> 00:02:26,879
within 1.3 astronomical units of the sun

56
00:02:30,710 --> 00:02:28,160
for those who don't speak in

57
00:02:32,550 --> 00:02:30,720
astronomical units on a regular basis

58
00:02:34,229 --> 00:02:32,560
one astronomical unit is the average

59
00:02:36,790 --> 00:02:34,239
distance between the earth and the sun

60
00:02:38,949 --> 00:02:36,800
it's about 93 million miles

61
00:02:40,949 --> 00:02:38,959
for a mission like osiris-rex the most

62
00:02:45,670 --> 00:02:40,959
accessible asteroids for a spacecraft to

63
00:02:47,910 --> 00:02:45,680

reach are located between 0.8 and 1.6 au

64
00:02:50,229 --> 00:02:47,920
the ideal ashtray destination also has

65
00:02:52,390 --> 00:02:50,239
an earth-like orbit one that is fairly

66
00:02:54,630 --> 00:02:52,400
circular and low in inclination so it's

67
00:02:58,710 --> 00:02:54,640
in a similar plane to ours

68
00:03:01,110 --> 00:02:58,720
bennu is and bennu orbits between 0.9

69
00:03:04,390 --> 00:03:01,120
and 1.36 au

70
00:03:06,630 --> 00:03:04,400
it orbits the sun every 1.2 years and it

71
00:03:08,470 --> 00:03:06,640
passes by earth every six years with an

72
00:03:10,630 --> 00:03:08,480
inclination that's only six degrees

73
00:03:12,630 --> 00:03:10,640
different than ours so it really is

74
00:03:16,229 --> 00:03:12,640
optimal for accessibility for the

75
00:03:18,070 --> 00:03:16,239
spacecraft to go to and then return from

76
00:03:19,589 --> 00:03:18,080
the next criteria for selection was

77
00:03:21,589 --> 00:03:19,599
finding an asteroid that was the right

78
00:03:23,910 --> 00:03:21,599
size to enable two critical portions of

79
00:03:25,990 --> 00:03:23,920
the mission the proximity operations

80
00:03:27,910 --> 00:03:26,000
close to the asteroid and the actual

81
00:03:30,309 --> 00:03:27,920
collection of the sample and go ahead

82
00:03:32,390 --> 00:03:30,319
and start my next graphic

83
00:03:34,229 --> 00:03:32,400
asteroids with small diameters rotate

84
00:03:35,430 --> 00:03:34,239
more rapidly than those with large

85
00:03:37,910 --> 00:03:35,440
diameters

86
00:03:40,789 --> 00:03:37,920
for an asteroid that has a smaller

87
00:03:42,630 --> 00:03:40,799
diameter than 200 meters it can rotate

88
00:03:44,789 --> 00:03:42,640

rapidly enough that some of the material

89
00:03:46,789 --> 00:03:44,799
on the surface will be ejected

90
00:03:49,270 --> 00:03:46,799
furthermore it's difficult to match the

91
00:03:51,830 --> 00:03:49,280
rotation speed of a rapidly rotating

92
00:03:54,710 --> 00:03:51,840
object so we need an object that's at

93
00:03:58,789 --> 00:03:54,720
least 200 meters in diameter

94
00:04:01,429 --> 00:03:58,799
bennu is actually 492 meters in diameter

95
00:04:04,710 --> 00:04:01,439
at its equatorial bulge and its rotation

96
00:04:07,910 --> 00:04:04,720
speed is only 4.3 hours so we'll be able

97
00:04:10,149 --> 00:04:07,920
to match the rotation speed of it and do

98
00:04:12,869 --> 00:04:10,159
a safe smooth

99
00:04:15,270 --> 00:04:12,879
slow high five to collect that sample

100
00:04:17,990 --> 00:04:15,280
that we will then return to earth

101
00:04:20,469 --> 00:04:18,000
the final criteria that made bennu the

102
00:04:22,310 --> 00:04:20,479
choice destination asteroid for us was

103
00:04:23,990 --> 00:04:22,320
its composition and go ahead and start

104
00:04:25,990 --> 00:04:24,000
my third graphic

105
00:04:27,909 --> 00:04:26,000
asteroids are categorized into different

106
00:04:29,189 --> 00:04:27,919
types based on their observed chemical

107
00:04:30,710 --> 00:04:29,199
composition

108
00:04:32,550 --> 00:04:30,720
in the visible and infrared light

109
00:04:34,230 --> 00:04:32,560
minerals have unique signatures somewhat

110
00:04:36,150 --> 00:04:34,240
like fingerprints

111
00:04:38,150 --> 00:04:36,160
depending upon the features observed

112
00:04:39,909 --> 00:04:38,160
scientists are able to identify various

113
00:04:41,830 --> 00:04:39,919

organic materials

114
00:04:44,070 --> 00:04:41,840
the most primitive asteroids are carbon

115
00:04:46,070 --> 00:04:44,080
rich and are believed to have material

116
00:04:48,469 --> 00:04:46,080
preserved from about four and a half

117
00:04:50,629 --> 00:04:48,479
billion years ago around the formation

118
00:04:52,550 --> 00:04:50,639
of our solar system

119
00:04:55,590 --> 00:04:52,560
these asteroids could contain organic

120
00:04:57,670 --> 00:04:55,600
molecules volatiles and amino acids that

121
00:04:59,590 --> 00:04:57,680
may have been the precursors to life on

122
00:05:00,790 --> 00:04:59,600
earth or elsewhere within our solar

123
00:05:02,629 --> 00:05:00,800
system

124
00:05:05,590 --> 00:05:02,639
telescopic measurements suggest that

125
00:05:07,749 --> 00:05:05,600
bennu surface is rich in carbon

126
00:05:10,230 --> 00:05:07,759
thanks to extensive measurements in the

127
00:05:11,830 --> 00:05:10,240
visible infrared as well as in the radar

128
00:05:12,870 --> 00:05:11,840
which is what this map of bennu was made

129
00:05:14,950 --> 00:05:12,880
off of

130
00:05:17,029 --> 00:05:14,960
bennu is the best understood near-earth

131
00:05:18,550 --> 00:05:17,039
asteroid that has not been visited by a

132
00:05:20,629 --> 00:05:18,560
spacecraft

133
00:05:23,189 --> 00:05:20,639
and with the return to earth of these

134
00:05:26,310 --> 00:05:23,199
pristine samples with a known geologic

135
00:05:28,150 --> 00:05:26,320
context we will enable precise analyses

136
00:05:31,350 --> 00:05:28,160
that simply cannot be

137
00:05:33,510 --> 00:05:31,360
duplicated by space-based observations

138
00:05:34,790 --> 00:05:33,520

or with studying

139
00:05:37,430 --> 00:05:34,800
meteorites

140
00:05:38,469 --> 00:05:37,440
so bennu's size primitive and rich

141
00:05:40,150 --> 00:05:38,479
composition

142
00:05:42,550 --> 00:05:40,160
in orbit make it one of the most

143
00:05:44,629 --> 00:05:42,560
fascinating accessible asteroids and

144
00:05:47,029 --> 00:05:44,639
that is why it was ultimately chosen as

145
00:05:48,070 --> 00:05:47,039
the target asteroid for the osiris-rex

146
00:05:49,830 --> 00:05:48,080
mission

147
00:05:51,110 --> 00:05:49,840
so jason is now going to talk about the

148
00:05:53,830 --> 00:05:51,120
actual sample and what we're going to be

149
00:05:56,870 --> 00:05:53,840
bringing back so thank you osiris-rex

150
00:05:58,309 --> 00:05:56,880
brings back a large bounty of sample for

151
00:06:00,550 --> 00:05:58,319
of the early solar system can have the

152
00:06:02,550 --> 00:06:00,560
first graphic please

153
00:06:04,870 --> 00:06:02,560
so you have heard about how bennu is a

154
00:06:06,469 --> 00:06:04,880
fantastic target asteroid in turn we

155
00:06:08,870 --> 00:06:06,479
have a purpose-built fantastic

156
00:06:10,469 --> 00:06:08,880
spacecraft the crux of osiris-rex is

157
00:06:13,110 --> 00:06:10,479
origins the search the origin of the

158
00:06:15,990 --> 00:06:13,120
solar system and of life itself

159
00:06:17,749 --> 00:06:16,000
and for that it's all about the sample

160
00:06:19,670 --> 00:06:17,759
meticulous testing and cleaning are

161
00:06:21,590 --> 00:06:19,680
necessary to collect and return a

162
00:06:23,430 --> 00:06:21,600
pristine sample with the well understood

163
00:06:25,749 --> 00:06:23,440

well characterized spacecraft from well

164
00:06:27,510 --> 00:06:25,759
understood well characterized asteroid

165
00:06:29,749 --> 00:06:27,520
the design of the oceanfront spacecraft

166
00:06:30,710 --> 00:06:29,759
instruments and operations all serve to

167
00:06:33,189 --> 00:06:30,720
return

168
00:06:35,909 --> 00:06:33,199
this organic rich sample safely with

169
00:06:37,270 --> 00:06:35,919
geological context with the rest of menu

170
00:06:39,830 --> 00:06:37,280
then allow comparisons with other

171
00:06:41,189 --> 00:06:39,840
asteroids and with meteorites

172
00:06:43,029 --> 00:06:41,199
after months of characterization and

173
00:06:45,430 --> 00:06:43,039
rehearsals the assassinate spacecraft

174
00:06:47,270 --> 00:06:45,440
autonomously descends to safely collect

175
00:06:49,430 --> 00:06:47,280
at least 60 grams as much as two

176
00:06:51,189 --> 00:06:49,440
kilograms of surface stones and dust

177
00:06:52,950 --> 00:06:51,199
this is a huge bounty

178
00:06:54,390 --> 00:06:52,960
after the sample is collected is locked

179
00:06:58,390 --> 00:06:54,400
in the sample return capsule until the

180
00:07:00,070 --> 00:06:58,400
spacecraft delivers it to earth in 2023

181
00:07:02,070 --> 00:07:00,080
to keep this precious sample safe there

182
00:07:04,469 --> 00:07:02,080
are no other science operations after

183
00:07:05,749 --> 00:07:04,479
the sample is stowed

184
00:07:07,350 --> 00:07:05,759
and this will

185
00:07:09,270 --> 00:07:07,360
allow us to

186
00:07:12,150 --> 00:07:09,280
make sure that the sample is safe and

187
00:07:14,629 --> 00:07:12,160
that the spacecraft is safe by not

188
00:07:16,469 --> 00:07:14,639

interjecting other possible risks the

189
00:07:19,029 --> 00:07:16,479
formation of the solar system was a

190
00:07:20,710 --> 00:07:19,039
violent but dimly recorded time although

191
00:07:23,350 --> 00:07:20,720
most director of the ancient

192
00:07:24,790 --> 00:07:23,360
earth is lost to the dynamic geology

193
00:07:26,629 --> 00:07:24,800
that shaped our planet there are lines

194
00:07:28,629 --> 00:07:26,639
of evidence that indicate that heavy

195
00:07:30,790 --> 00:07:28,639
bombardment by debris from the formation

196
00:07:32,309 --> 00:07:30,800
of the solar system

197
00:07:33,909 --> 00:07:32,319
around the same time

198
00:07:36,710 --> 00:07:33,919
helped form the oceans and then a few

199
00:07:39,189 --> 00:07:36,720
hundred million years later life

200
00:07:40,629 --> 00:07:39,199
the detailed chemistry of what was on

201
00:07:42,230 --> 00:07:40,639
and delivered to the earth on mars

202
00:07:44,629 --> 00:07:42,240
europa or enceladus cannot be found in

203
00:07:46,629 --> 00:07:44,639
earth rocks this history was recorded in

204
00:07:48,309 --> 00:07:46,639
the minerals compounds and isotopes from

205
00:07:50,309 --> 00:07:48,319
meteorites and their parent asteroids

206
00:07:51,670 --> 00:07:50,319
but meteorites land on the ground and we

207
00:07:53,510 --> 00:07:51,680
never know where they come from

208
00:07:55,350 --> 00:07:53,520
furthermore organic rich

209
00:07:57,270 --> 00:07:55,360
meteorites quickly become contaminated

210
00:07:58,950 --> 00:07:57,280
with the compounds of life

211
00:08:00,150 --> 00:07:58,960
these compounds are the are most

212
00:08:01,830 --> 00:08:00,160
important to understand our origins and

213
00:08:03,749 --> 00:08:01,840

meteorites and can only be understood by

214
00:08:04,869 --> 00:08:03,759
careful and tedious laboratory work if

215
00:08:06,869 --> 00:08:04,879
at all

216
00:08:09,670 --> 00:08:06,879
to maximize the sample of our si of our

217
00:08:11,670 --> 00:08:09,680
samples on uh on bennu we have a very

218
00:08:13,189 --> 00:08:11,680
clean spacecraft and well as a detailed

219
00:08:15,510 --> 00:08:13,199
record of the materials used to process

220
00:08:17,350 --> 00:08:15,520
to make it this equips scientists who

221
00:08:19,270 --> 00:08:17,360
study the samples with tools directly

222
00:08:21,029 --> 00:08:19,280
verify what was discovered in bennu's

223
00:08:22,070 --> 00:08:21,039
rocks are not accidentally carried from

224
00:08:23,990 --> 00:08:22,080
earth

225
00:08:26,230 --> 00:08:24,000
a scientist in my laboratory dr jamie

226
00:08:28,309 --> 00:08:26,240
usola recently recently led a team to

227
00:08:30,790 --> 00:08:28,319
analyze some apollo samples to learn the

228
00:08:32,709 --> 00:08:30,800
origin of their amino acids she was not

229
00:08:34,469 --> 00:08:32,719
yet born when the sample was collected

230
00:08:35,829 --> 00:08:34,479
used instruments not yet invented and

231
00:08:37,269 --> 00:08:35,839
answered questions beyond the reach of

232
00:08:39,430 --> 00:08:37,279
science at the time

233
00:08:40,709 --> 00:08:39,440
osiris-rex like stardust mission before

234
00:08:43,670 --> 00:08:40,719
us

235
00:08:45,509 --> 00:08:43,680
will answer questions unanticipated at

236
00:08:47,350 --> 00:08:45,519
the time of launch

237
00:08:49,190 --> 00:08:47,360
even questions we didn't design the are

238
00:08:50,630 --> 00:08:49,200

sort of rex to answer just as we've

239
00:08:52,550 --> 00:08:50,640
learned from

240
00:08:54,710 --> 00:08:52,560
the stardust com sample return mission

241
00:08:56,150 --> 00:08:54,720
before us and hayabusa and high booster

242
00:08:58,230 --> 00:08:56,160
2 missions on how to rendezvous with

243
00:09:00,230 --> 00:08:58,240
comet collect and return samples to

244
00:09:01,910 --> 00:09:00,240
earth we've learned

245
00:09:05,269 --> 00:09:01,920
from near and rosette about how to

246
00:09:07,269 --> 00:09:05,279
maneuver around the small body

247
00:09:09,269 --> 00:09:07,279
samples of bending will be studied

248
00:09:10,630 --> 00:09:09,279
by science instruments too large too

249
00:09:12,470 --> 00:09:10,640
power hungry or too delicate in

250
00:09:14,150 --> 00:09:12,480
laboratories around the world we would

251
00:09:15,509 --> 00:09:14,160
dissect the sample to the atomic level

252
00:09:17,509 --> 00:09:15,519
to better understand the origin of the

253
00:09:19,030 --> 00:09:17,519
solar system and our place within it

254
00:09:20,550 --> 00:09:19,040
the sample return capsule will enter the

255
00:09:22,470 --> 00:09:20,560
earth's atmosphere to deliver precious

256
00:09:23,750 --> 00:09:22,480
fragments of the early solar system to

257
00:09:26,470 --> 00:09:23,760
the utah desert in the morning of

258
00:09:28,230 --> 00:09:26,480
september 24th 2023

259
00:09:30,070 --> 00:09:28,240
since 75 percent of the sample we

260
00:09:32,790 --> 00:09:30,080
archived for scientists to request a

261
00:09:34,230 --> 00:09:32,800
study perhaps you your children or your

262
00:09:35,829 --> 00:09:34,240
grandchildren will grow up to study the

263
00:09:37,829 --> 00:09:35,839

samples collected by the spacecraft we

264
00:09:40,790 --> 00:09:37,839
are launching now now danny would tell

265
00:09:42,550 --> 00:09:40,800
us more about how we choose the sample

266
00:09:44,710 --> 00:09:42,560
thanks jason

267
00:09:47,350 --> 00:09:44,720
so bennu is going to be the first

268
00:09:49,110 --> 00:09:47,360
carbonaceous asteroid that nasa has had

269
00:09:51,829 --> 00:09:49,120
the opportunity to map the entire

270
00:09:54,790 --> 00:09:51,839
surface of and so this is very exciting

271
00:09:57,190 --> 00:09:54,800
can i get my first graphic please

272
00:09:59,350 --> 00:09:57,200
so mapping will begin by determining the

273
00:10:02,230 --> 00:09:59,360
shape of the asteroid and understanding

274
00:10:04,630 --> 00:10:02,240
the shape of bennu is of incredible

275
00:10:06,949 --> 00:10:04,640
importance so that we understand how to

276
00:10:08,470 --> 00:10:06,959
safely navigate around this body

277
00:10:09,910 --> 00:10:08,480
navigation will have some challenges

278
00:10:11,430 --> 00:10:09,920
because bennu will be the smallest

279
00:10:13,269 --> 00:10:11,440
object that we've ever orbited a

280
00:10:14,949 --> 00:10:13,279
spacecraft around

281
00:10:17,110 --> 00:10:14,959
one of the primary tools that we will

282
00:10:20,230 --> 00:10:17,120
use for mapping the asteroid will be the

283
00:10:21,990 --> 00:10:20,240
osiris-rex camera suite or ocams a trio

284
00:10:23,110 --> 00:10:22,000
of cameras built by the university of

285
00:10:25,430 --> 00:10:23,120
arizona

286
00:10:27,509 --> 00:10:25,440
in conjunction with ocams the four other

287
00:10:30,550 --> 00:10:27,519
instruments on the spacecraft will go

288
00:10:33,110 --> 00:10:30,560

ahead and map bennu first globally and

289
00:10:35,750 --> 00:10:33,120
then locally by the end of our local

290
00:10:38,389 --> 00:10:35,760
mapping campaign we will be able to see

291
00:10:42,310 --> 00:10:38,399
an object the size of a penny

292
00:10:48,069 --> 00:10:44,870
next graphic please

293
00:10:51,829 --> 00:10:48,079
so before sampling mapping will take

294
00:10:53,350 --> 00:10:51,839
place over a year and a half to a two

295
00:10:56,310 --> 00:10:53,360
year period

296
00:10:58,310 --> 00:10:56,320
and during this two years

297
00:11:01,350 --> 00:10:58,320
the osiris-rex spacecraft will be

298
00:11:03,590 --> 00:11:01,360
absolutely dedicated to

299
00:11:06,389 --> 00:11:03,600
finding the best place on the surface of

300
00:11:08,710 --> 00:11:06,399
bennu to collect a sample from

301
00:11:10,790 --> 00:11:08,720
this is pretty incredible because at the

302
00:11:12,710 --> 00:11:10,800
end of this two-year period scientists

303
00:11:15,829 --> 00:11:12,720
will know more about bennu than we know

304
00:11:18,069 --> 00:11:15,839
about any other near-earth asteroids so

305
00:11:20,230 --> 00:11:18,079
we're collecting again an unprecedented

306
00:11:23,269 --> 00:11:20,240
data set

307
00:11:25,190 --> 00:11:23,279
the mapping will take place globally so

308
00:11:27,590 --> 00:11:25,200
that we first can characterize and

309
00:11:30,710 --> 00:11:27,600
understand the major properties of this

310
00:11:33,350 --> 00:11:30,720
small world and then we'll move along to

311
00:11:35,829 --> 00:11:33,360
a local mapping phase in order to

312
00:11:37,829 --> 00:11:35,839
evaluate the suitability of individual

313
00:11:38,870 --> 00:11:37,839

candidate sample sites

314
00:11:41,030 --> 00:11:38,880
so

315
00:11:44,310 --> 00:11:41,040
the primary importance of mapping at

316
00:11:45,110 --> 00:11:44,320
bennu is to find this great sample site

317
00:11:49,509 --> 00:11:45,120
and

318
00:11:50,949 --> 00:11:49,519
sample from it but once we have a sample

319
00:11:52,870 --> 00:11:50,959
of bennu

320
00:11:55,030 --> 00:11:52,880
the maps will also provide critical

321
00:11:58,710 --> 00:11:55,040
context for that sample

322
00:12:03,430 --> 00:12:01,509
so maps acquired during this year and a

323
00:12:04,470 --> 00:12:03,440
half to two year period

324
00:12:06,629 --> 00:12:04,480
will

325
00:12:09,590 --> 00:12:06,639
place the sample into critical context

326
00:12:12,389 --> 00:12:09,600
and the sample of bennu that will get

327
00:12:14,870 --> 00:12:12,399
returned to earth is uh at a minimum

328
00:12:16,710 --> 00:12:14,880
going to be 60 grams so to get a visual

329
00:12:19,670 --> 00:12:16,720
for that that's about uh four

330
00:12:21,910 --> 00:12:19,680
tablespoons of packed brown sugar

331
00:12:24,470 --> 00:12:21,920
and because this represents a small

332
00:12:26,389 --> 00:12:24,480
portion of the overall asteroid

333
00:12:28,230 --> 00:12:26,399
the maps that we collect and the remote

334
00:12:30,710 --> 00:12:28,240
sensing data that we collect at the

335
00:12:32,710 --> 00:12:30,720
asteroid are going to provide that vital

336
00:12:35,829 --> 00:12:32,720
the vital link that we need to connect

337
00:12:38,069 --> 00:12:35,839
this sample into the global context for

338
00:12:40,069 --> 00:12:38,079

the world that is venue

339
00:12:42,310 --> 00:12:40,079
so now that we've had a mission overview

340
00:12:44,710 --> 00:12:42,320
talked about the sample and the mapping

341
00:12:46,629 --> 00:12:44,720
uh back to you nancy thank you daniella

342
00:12:48,710 --> 00:12:46,639
so now we're ready to open the floor for

343
00:12:50,870 --> 00:12:48,720
questions please wait for the microphone

344
00:12:53,269 --> 00:12:50,880
and state your name and affiliation

345
00:12:58,230 --> 00:12:53,279
okay right here

346
00:13:00,710 --> 00:12:58,949
hi

347
00:13:02,310 --> 00:13:00,720
bill jelen from we report space a

348
00:13:03,670 --> 00:13:02,320
question on the mapping so the the

349
00:13:05,350 --> 00:13:03,680
global mapping

350
00:13:07,269 --> 00:13:05,360
if they determine through the arkovsky

351
00:13:08,310 --> 00:13:07,279
effect that eventually this thing would

352
00:13:09,910 --> 00:13:08,320
hit us

353
00:13:11,829 --> 00:13:09,920
then we have an opportunity in 2135 when

354
00:13:13,750 --> 00:13:11,839
it passes between the earth and the moon

355
00:13:15,750 --> 00:13:13,760
to have a close approach

356
00:13:17,430 --> 00:13:15,760
how will you save the maps well the

357
00:13:19,030 --> 00:13:17,440
global maps be transmitted back to us

358
00:13:22,470 --> 00:13:19,040
and and saved in case we ever have to

359
00:13:24,069 --> 00:13:22,480
figure out the geography of banu in case

360
00:13:25,190 --> 00:13:24,079
we need to try and do something to

361
00:13:27,829 --> 00:13:25,200
divert it

362
00:13:29,910 --> 00:13:27,839
that's a great question i mean even

363
00:13:31,829 --> 00:13:29,920

security is one of the osiris-rex

364
00:13:34,310 --> 00:13:31,839
mission objectives but also from the the

365
00:13:35,350 --> 00:13:34,320
spectral interpretation a portion of our

366
00:13:36,790 --> 00:13:35,360
acronym

367
00:13:38,710 --> 00:13:36,800
the data that we collect and then

368
00:13:40,629 --> 00:13:38,720
eventually build into maps for bennu

369
00:13:42,949 --> 00:13:40,639
will be archived by nasa's planetary

370
00:13:45,269 --> 00:13:42,959
data system and so nasa has a long

371
00:13:46,870 --> 00:13:45,279
history of ensuring that data is

372
00:13:48,389 --> 00:13:46,880
preserved and archived for future

373
00:13:50,949 --> 00:13:48,399
generations to examine

374
00:13:53,030 --> 00:13:50,959
and this definitely includes the maps

375
00:13:56,230 --> 00:13:53,040
and all of the the instrument data that

376
00:14:00,150 --> 00:13:56,240
we will be collected by the spacecraft

377
00:14:02,550 --> 00:14:00,160
okay thank you right here in front

378
00:14:05,030 --> 00:14:02,560
i'm jim siegel i'm with the celebration

379
00:14:07,990 --> 00:14:05,040
news and space flight insider i'm

380
00:14:10,550 --> 00:14:08,000
intrigued by the um

381
00:14:13,509 --> 00:14:10,560
dust materials that you expect to find

382
00:14:15,509 --> 00:14:13,519
on the asteroid for example um

383
00:14:17,269 --> 00:14:15,519
what makes you think there's dust there

384
00:14:19,750 --> 00:14:17,279
what kind of evidence do you have or

385
00:14:22,069 --> 00:14:19,760
experience and then and secondly what

386
00:14:24,710 --> 00:14:22,079
would be the texture of this dust would

387
00:14:27,269 --> 00:14:24,720
this be like talcum powder or sugar or

388
00:14:29,030 --> 00:14:27,279

gravel or what

389
00:14:31,430 --> 00:14:29,040
so we have numerous lines of evidence

390
00:14:32,790 --> 00:14:31,440
that tell us the texture of the surface

391
00:14:35,189 --> 00:14:32,800
of bennu

392
00:14:37,110 --> 00:14:35,199
both from the thermal inertia

393
00:14:39,990 --> 00:14:37,120
where you can look at the uh the

394
00:14:43,350 --> 00:14:40,000
temperature of like a beach versus large

395
00:14:46,069 --> 00:14:43,360
stones and the temperature changes

396
00:14:47,990 --> 00:14:46,079
from day to night uh quickly on smaller

397
00:14:51,350 --> 00:14:48,000
textures versus slowly with large

398
00:14:53,430 --> 00:14:51,360
textures as well as using uh polarized

399
00:14:56,629 --> 00:14:53,440
radar from the goldstone andersebo

400
00:14:59,189 --> 00:14:56,639
telescopes to give us a size bin of the

401
00:15:01,189 --> 00:14:59,199
surface of the rocks

402
00:15:02,710 --> 00:15:01,199
we know that there are one centimeter

403
00:15:05,910 --> 00:15:02,720
sized stones

404
00:15:08,389 --> 00:15:05,920
which is ideal for the the tagsam

405
00:15:10,069 --> 00:15:08,399
device to collect and based on a

406
00:15:11,829 --> 00:15:10,079
reasonable size frequency distribution

407
00:15:15,350 --> 00:15:11,839
by looking at other asteroids including

408
00:15:17,590 --> 00:15:15,360
itakawa as visited by uh by hayabusa we

409
00:15:19,350 --> 00:15:17,600
can understand how

410
00:15:22,069 --> 00:15:19,360
smaller and smaller pieces

411
00:15:24,150 --> 00:15:22,079
would would break up into dust and so we

412
00:15:27,110 --> 00:15:24,160
cannot see the dust from the earth

413
00:15:29,350 --> 00:15:27,120

but it almost cannot not be there but

414
00:15:31,269 --> 00:15:29,360
the stones that we need which are the

415
00:15:33,189 --> 00:15:31,279
high value samples we have high

416
00:15:37,269 --> 00:15:33,199
confidence that they are present based

417
00:15:42,470 --> 00:15:40,389
okay right here

418
00:15:44,629 --> 00:15:42,480
thanks guys mike wahl from

419
00:15:45,749 --> 00:15:44,639
dykespace.com um so so i'm just

420
00:15:47,269 --> 00:15:45,759
wondering it

421
00:15:49,430 --> 00:15:47,279
like would there be any advantages to

422
00:15:51,590 --> 00:15:49,440
trying to get more than one sample or

423
00:15:52,629 --> 00:15:51,600
are you just gonna get one sample and

424
00:15:54,870 --> 00:15:52,639
you're sure you've got it then you're

425
00:15:56,389 --> 00:15:54,880
gonna go because there would be more

426
00:15:57,829 --> 00:15:56,399
risks involved going back to try to get

427
00:16:00,310 --> 00:15:57,839
something else

428
00:16:01,910 --> 00:16:00,320
so so if you're sure you have one

429
00:16:03,350 --> 00:16:01,920
i mean could you just kind of talk about

430
00:16:04,629 --> 00:16:03,360
are there any benefits to trying to get

431
00:16:08,710 --> 00:16:04,639
a second one if you could or is that

432
00:16:13,189 --> 00:16:10,710
so i'll go ahead and take that um

433
00:16:15,269 --> 00:16:13,199
so what we're going to do is after we go

434
00:16:17,189 --> 00:16:15,279
out and do the slow five second high

435
00:16:18,710 --> 00:16:17,199
five maneuver with the nitrogen gas and

436
00:16:20,069 --> 00:16:18,720
collect the sample we're going to

437
00:16:21,829 --> 00:16:20,079
actually maneuver away from the

438
00:16:23,990 --> 00:16:21,839

spacecraft so that we can rotate our

439
00:16:26,310 --> 00:16:24,000
spacecraft to measure the mass

440
00:16:29,030 --> 00:16:26,320
once we know we have 60 grams in there

441
00:16:30,870 --> 00:16:29,040
we're going to snow and move away from

442
00:16:32,949 --> 00:16:30,880
the asteroid enough to where we feel

443
00:16:34,949 --> 00:16:32,959
that our spacecraft's in a safe position

444
00:16:37,670 --> 00:16:34,959
our priority is to bring back at least

445
00:16:39,590 --> 00:16:37,680
60 grams of pristine material so once we

446
00:16:41,509 --> 00:16:39,600
have that we're not going to try to

447
00:16:42,949 --> 00:16:41,519
touch that again we've got it it's

448
00:16:45,749 --> 00:16:42,959
getting stowed

449
00:16:48,310 --> 00:16:45,759
it's getting ready to come home

450
00:16:50,710 --> 00:16:48,320
if i follow up sure so

451
00:16:51,749 --> 00:16:50,720
as a scientist i always want more

452
00:16:53,269 --> 00:16:51,759
but

453
00:16:55,430 --> 00:16:53,279
um

454
00:16:57,509 --> 00:16:55,440
the science team has been conditioned to

455
00:17:00,310 --> 00:16:57,519
understand how to minimize risk

456
00:17:01,430 --> 00:17:00,320
and have respect for engineering reality

457
00:17:03,110 --> 00:17:01,440
and so

458
00:17:05,590 --> 00:17:03,120
i would love to have a spacecraft that

459
00:17:07,750 --> 00:17:05,600
is covered in semper return capsules

460
00:17:10,710 --> 00:17:07,760
um a friend of mine likes to say scott

461
00:17:12,949 --> 00:17:10,720
sanford who's on the mission uh that if

462
00:17:14,710 --> 00:17:12,959
engineers designed a spacecraft they

463
00:17:17,350 --> 00:17:14,720

would launch a bowling ball and get

464
00:17:19,270 --> 00:17:17,360
telemetry and declare mission success if

465
00:17:21,189 --> 00:17:19,280
scientists designed missions they would

466
00:17:23,350 --> 00:17:21,199
design a spacecraft that's too heavy

467
00:17:26,309 --> 00:17:23,360
with instruments to get off the pad so

468
00:17:28,630 --> 00:17:26,319
coming up with with a middle ground

469
00:17:31,110 --> 00:17:28,640
where we can ensure we get one high

470
00:17:32,470 --> 00:17:31,120
value sample instead of risking it all

471
00:17:35,669 --> 00:17:32,480
and getting two

472
00:17:38,549 --> 00:17:35,679
is just not worth the chance

473
00:17:39,909 --> 00:17:38,559
one is a lifetime of data anyway

474
00:17:42,549 --> 00:17:39,919
great thank you we're gonna go to the

475
00:17:49,669 --> 00:17:42,559
phone lines and we have mark garch on

476
00:17:53,510 --> 00:17:51,510
thank you for this informative briefing

477
00:17:56,150 --> 00:17:53,520
this afternoon on this historical

478
00:17:57,190 --> 00:17:56,160
mission of osiris-rex is going to be

479
00:17:58,870 --> 00:17:57,200
incredible

480
00:18:02,070 --> 00:17:58,880
my questions are this

481
00:18:05,430 --> 00:18:02,080
in using the tag sam to take the sample

482
00:18:08,390 --> 00:18:05,440
from the carbon rich asteroid bennu

483
00:18:10,630 --> 00:18:08,400
what will have to be seen or detected by

484
00:18:14,230 --> 00:18:10,640
the visible light cameras and

485
00:18:17,909 --> 00:18:14,240
spectrometer to indicate the exact place

486
00:18:21,430 --> 00:18:17,919
of the sample of regolith to be taken

487
00:18:24,470 --> 00:18:21,440
and how far from the surface of bennu

488
00:18:26,630 --> 00:18:24,480

will the sample location be able to be

489
00:18:28,310 --> 00:18:26,640
detected

490
00:18:30,950 --> 00:18:28,320
okay so i can take the first part of

491
00:18:32,870 --> 00:18:30,960
this question um so one of the

492
00:18:36,549 --> 00:18:32,880
instruments uh on the

493
00:18:39,510 --> 00:18:36,559
osiris-rex spacecraft is called sam cam

494
00:18:42,390 --> 00:18:39,520
and the purpose of samcam is to watch

495
00:18:44,549 --> 00:18:42,400
the tag event and then later on to

496
00:18:45,830 --> 00:18:44,559
verify that there has been some sample

497
00:18:48,789 --> 00:18:45,840
collected

498
00:18:50,310 --> 00:18:48,799
by the tag sam so the tag sam has it's a

499
00:18:52,870 --> 00:18:50,320
ring as we saw some of the images

500
00:18:54,549 --> 00:18:52,880
earlier and there's a little bit of

501
00:18:58,310 --> 00:18:54,559
you can think of it almost like steel

502
00:19:00,549 --> 00:18:58,320
velcro at the edge of this annulus and

503
00:19:02,870 --> 00:19:00,559
that will also interface with the

504
00:19:06,390 --> 00:19:02,880
surface of bennu and material will

505
00:19:09,350 --> 00:19:06,400
attach to it so we will not only watch

506
00:19:11,750 --> 00:19:09,360
the sampling event but we will also at

507
00:19:13,990 --> 00:19:11,760
some distance away from bennu go ahead

508
00:19:16,789 --> 00:19:14,000
and turn the tag sam so that we can look

509
00:19:21,909 --> 00:19:16,799
at it with samcam and verify that we

510
00:19:26,070 --> 00:19:23,990
okay we're now going to take some

511
00:19:28,950 --> 00:19:26,080
questions from social media media please

512
00:19:31,029 --> 00:19:28,960
aries okay thanks um this question is

513
00:19:32,789 --> 00:19:31,039

from ada quasar calm

514
00:19:34,950 --> 00:19:32,799
and uh they want to know what is the

515
00:19:37,029 --> 00:19:34,960
added value of retrieving the sample

516
00:19:38,710 --> 00:19:37,039
instead of analyzing it using on-board

517
00:19:40,789 --> 00:19:38,720
instruments

518
00:19:43,909 --> 00:19:40,799
uh nasa has a history of developing

519
00:19:46,390 --> 00:19:43,919
fantastic onboard instruments such as

520
00:19:49,510 --> 00:19:46,400
the the great instrument suite on the

521
00:19:51,590 --> 00:19:49,520
curiosity rover on mars right now

522
00:19:53,990 --> 00:19:51,600
the problem is that those instruments

523
00:19:56,630 --> 00:19:54,000
however fantastic they are the design

524
00:19:59,750 --> 00:19:56,640
has to be fixed years before launch to

525
00:20:01,990 --> 00:19:59,760
minimize uh risk of change and also to

526
00:20:04,390 --> 00:20:02,000
make sure that the instruments are light

527
00:20:06,070 --> 00:20:04,400
and robust to the launch environments

528
00:20:08,630 --> 00:20:06,080
and that they don't need frequent

529
00:20:10,310 --> 00:20:08,640
tune-ups like laboratory instruments do

530
00:20:12,789 --> 00:20:10,320
in the case when you bring a sample back

531
00:20:14,789 --> 00:20:12,799
to earth you can use laboratories the

532
00:20:17,029 --> 00:20:14,799
size of the spacecraft even the size of

533
00:20:18,710 --> 00:20:17,039
buildings like like synchrotron

534
00:20:21,669 --> 00:20:18,720
facilities that were used to study

535
00:20:23,590 --> 00:20:21,679
stardust samples and you can take uh

536
00:20:25,190 --> 00:20:23,600
rocks and slice them up into tiny tiny

537
00:20:28,549 --> 00:20:25,200
fragments and put them into these beam

538
00:20:30,950 --> 00:20:28,559

lines and manipulate them using people

539
00:20:34,149 --> 00:20:30,960
that are that have the ability to adjust

540
00:20:35,590 --> 00:20:34,159
these objects in ways that robots can't

541
00:20:37,430 --> 00:20:35,600
uh and then

542
00:20:39,110 --> 00:20:37,440
interrogate in ways in finer detail than

543
00:20:42,070 --> 00:20:39,120
you ever could and of course as we

544
00:20:44,789 --> 00:20:42,080
mentioned people not yet born with ideas

545
00:20:46,710 --> 00:20:44,799
that we didn't have now can test them in

546
00:20:49,029 --> 00:20:46,720
ways we couldn't even conceive of yeah

547
00:20:50,950 --> 00:20:49,039
just to follow on with that so

548
00:20:53,270 --> 00:20:50,960
60 grams is the smallest amount that

549
00:20:54,789 --> 00:20:53,280
we're intending on returning but that's

550
00:20:57,110 --> 00:20:54,799
still going to be the largest sample

551
00:20:59,190 --> 00:20:57,120
return since the apollo era so this

552
00:21:00,470 --> 00:20:59,200
really is a sample return mission that's

553
00:21:02,549 --> 00:21:00,480
going to be the gift that keeps on

554
00:21:04,070 --> 00:21:02,559
giving 25

555
00:21:06,230 --> 00:21:04,080
of this sample will go towards the

556
00:21:08,870 --> 00:21:06,240
science team in order to

557
00:21:10,789 --> 00:21:08,880
fulfill their objectives and then 75

558
00:21:12,470 --> 00:21:10,799
percent is going to be stored in our

559
00:21:14,950 --> 00:21:12,480
curation facility at johnson space

560
00:21:16,950 --> 00:21:14,960
flight center in order to allow future

561
00:21:18,230 --> 00:21:16,960
generations of scientists to use

562
00:21:19,590 --> 00:21:18,240
instruments that haven't even been

563
00:21:21,909 --> 00:21:19,600

invented yet

564
00:21:23,750 --> 00:21:21,919
so as jason mentioned earlier one of his

565
00:21:26,630 --> 00:21:23,760
colleagues at goddard is still working

566
00:21:28,789 --> 00:21:26,640
on the apollo samples now so this sample

567
00:21:30,549 --> 00:21:28,799
return osiris-rex is going to keep

568
00:21:32,710 --> 00:21:30,559
giving back to future and future

569
00:21:33,990 --> 00:21:32,720
generations of scientists it's really

570
00:21:37,510 --> 00:21:34,000
going to help us understand the solar

571
00:21:41,430 --> 00:21:39,510
to the next question we had which is uh

572
00:21:43,190 --> 00:21:41,440
how could this mission have an impact on

573
00:21:48,710 --> 00:21:43,200
future missions and which future

574
00:21:52,470 --> 00:21:49,990
so

575
00:21:54,470 --> 00:21:52,480
we're willing to share the answers here

576
00:21:56,630 --> 00:21:54,480
so we're really actually going to be

577
00:21:58,470 --> 00:21:56,640
able to the technologies that we have

578
00:22:01,029 --> 00:21:58,480
developed are going to help with several

579
00:22:03,270 --> 00:22:01,039
different types of missions to say small

580
00:22:04,789 --> 00:22:03,280
bodies in the future the first of which

581
00:22:06,950 --> 00:22:04,799
is going to be doing those close

582
00:22:10,310 --> 00:22:06,960
proximity operations being in that low

583
00:22:11,669 --> 00:22:10,320
gravity near the actual small body

584
00:22:14,549 --> 00:22:11,679
our mission has been specifically

585
00:22:16,390 --> 00:22:14,559
designed for that and our our type of

586
00:22:18,390 --> 00:22:16,400
research and design that we've done can

587
00:22:21,669 --> 00:22:18,400
be implemented towards future missions

588
00:22:24,149 --> 00:22:21,679

um the actual tag sam arm and then the

589
00:22:26,390 --> 00:22:24,159
the sample return capsule which was from

590
00:22:28,710 --> 00:22:26,400
stardust previously so we used a design

591
00:22:30,710 --> 00:22:28,720
that we know is tested and in well

592
00:22:32,710 --> 00:22:30,720
validated and works

593
00:22:35,350 --> 00:22:32,720
we will continue to keep using that

594
00:22:37,830 --> 00:22:35,360
design as we move forward so it's it's

595
00:22:39,350 --> 00:22:37,840
really the great thing about osiris-rex

596
00:22:40,789 --> 00:22:39,360
is the instrumentation on board the

597
00:22:42,870 --> 00:22:40,799
spacecraft is at the forefront of

598
00:22:44,630 --> 00:22:42,880
technology the sample return is at the

599
00:22:46,950 --> 00:22:44,640
forefront of technology the fact that

600
00:22:49,669 --> 00:22:46,960
we're able to actually be in low gravity

601
00:22:51,270 --> 00:22:49,679
around this small body and still

602
00:22:53,750 --> 00:22:51,280
maneuver and operate is at the forefront

603
00:22:55,669 --> 00:22:53,760
of technology so all of that from nasa

604
00:22:56,870 --> 00:22:55,679
is going to continue moving forward into

605
00:22:59,430 --> 00:22:56,880
more and more

606
00:23:01,430 --> 00:22:59,440
missions afterwards

607
00:23:07,510 --> 00:23:01,440
okay great right here in the front row

608
00:23:11,590 --> 00:23:09,430
hi ken kramer for universe today in the

609
00:23:13,430 --> 00:23:11,600
northeast astronomy forum um i have a

610
00:23:15,430 --> 00:23:13,440
question for um

611
00:23:18,549 --> 00:23:15,440
jason and um

612
00:23:19,990 --> 00:23:18,559
christina jason i think you mentioned

613
00:23:23,029 --> 00:23:20,000

after you collect the samples you're not

614
00:23:25,990 --> 00:23:23,039
going to do any more science um

615
00:23:27,270 --> 00:23:26,000
no no imaging is that is that why why

616
00:23:29,110 --> 00:23:27,280
would that be

617
00:23:30,630 --> 00:23:29,120
we move to after we collect the samples

618
00:23:31,669 --> 00:23:30,640
we move to a safe distance from the

619
00:23:33,669 --> 00:23:31,679
asteroid

620
00:23:34,630 --> 00:23:33,679
and all the primary objectives have

621
00:23:36,070 --> 00:23:34,640
already been done we've already

622
00:23:38,390 --> 00:23:36,080
thoroughly mapped and imaged and

623
00:23:40,230 --> 00:23:38,400
characterized the asteroid

624
00:23:42,230 --> 00:23:40,240
it's all about keeping that precious

625
00:23:45,350 --> 00:23:42,240
sample safe doing nothing that can

626
00:23:47,029 --> 00:23:45,360
possibly jeopardize it

627
00:23:48,630 --> 00:23:47,039
there

628
00:23:51,269 --> 00:23:48,640
we need to make sure that we can return

629
00:23:53,190 --> 00:23:51,279
the sample and not undergo any risk by

630
00:23:55,029 --> 00:23:53,200
getting closer to get better images we

631
00:23:57,350 --> 00:23:55,039
already have everything we need we need

632
00:23:59,510 --> 00:23:57,360
to show the same restraint that we have

633
00:24:02,230 --> 00:23:59,520
all along the program that's kept us on

634
00:24:04,789 --> 00:24:02,240
schedule under budget to make sure that

635
00:24:06,070 --> 00:24:04,799
we don't grow our scope and do things

636
00:24:08,390 --> 00:24:06,080
that we don't really need to do only

637
00:24:10,390 --> 00:24:08,400
what we have to do

638
00:24:11,669 --> 00:24:10,400

and that's for a few weeks or a few

639
00:24:13,430 --> 00:24:11,679
months

640
00:24:16,230 --> 00:24:13,440
it depends on exactly when we collect

641
00:24:18,310 --> 00:24:16,240
the sample there's a window

642
00:24:20,310 --> 00:24:18,320
but it could be several months okay for

643
00:24:22,070 --> 00:24:20,320
christina can can you show with your

644
00:24:25,190 --> 00:24:22,080
asteroid model there

645
00:24:27,590 --> 00:24:25,200
roughly uh how how will we be doing how

646
00:24:29,830 --> 00:24:27,600
you'll be doing the sample collection

647
00:24:31,430 --> 00:24:29,840
with the spacecraft what's the approach

648
00:24:33,669 --> 00:24:31,440
so i only have two hands and one of them

649
00:24:35,510 --> 00:24:33,679
has to hold the asteroid yeah so right

650
00:24:36,230 --> 00:24:35,520
it's probably a two guys start rotating

651
00:24:38,149 --> 00:24:36,240
us

652
00:24:39,669 --> 00:24:38,159
so basically what's going to happen is

653
00:24:42,149 --> 00:24:39,679
our spacecraft is going to go into the

654
00:24:44,070 --> 00:24:42,159
rotation period with it it's going to do

655
00:24:45,750 --> 00:24:44,080
lots of detailed mapping

656
00:24:47,830 --> 00:24:45,760
and then eventually when we feel safe

657
00:24:50,310 --> 00:24:47,840
and ready we're going to lock in and

658
00:24:53,029 --> 00:24:50,320
we're going to come down and do a very

659
00:24:54,789 --> 00:24:53,039
safe smooth high five

660
00:24:56,149 --> 00:24:54,799
and then we're going to back away from

661
00:24:58,870 --> 00:24:56,159
the asteroid

662
00:25:00,630 --> 00:24:58,880
make sure we have the mass we need and

663
00:25:04,789 --> 00:25:00,640

then we are going to stow that once we

664
00:25:05,830 --> 00:25:04,799
have it so stowed ready for departure

665
00:25:08,230 --> 00:25:05,840
and

666
00:25:10,789 --> 00:25:08,240
do you think it is more likely from the

667
00:25:12,149 --> 00:25:10,799
equator or from another area you know

668
00:25:14,710 --> 00:25:12,159
we're going to actually do detailed

669
00:25:16,710 --> 00:25:14,720
mapping of the entire surface of bennu

670
00:25:18,470 --> 00:25:16,720
as danny described and so what we're

671
00:25:20,230 --> 00:25:18,480
going to do is narrow that down to 12

672
00:25:21,750 --> 00:25:20,240
different selection sites i'm not going

673
00:25:23,029 --> 00:25:21,760
to say definitively where any of those

674
00:25:24,710 --> 00:25:23,039
sites are

675
00:25:26,549 --> 00:25:24,720
because the great news is we have the

676
00:25:28,789 --> 00:25:26,559
instrumentation on board to be able to

677
00:25:36,630 --> 00:25:28,799
be definitive about that after we do the

678
00:25:40,549 --> 00:25:38,549
hi jeff file space news

679
00:25:42,310 --> 00:25:40,559
if you hit the jackpot with tag sam

680
00:25:44,310 --> 00:25:42,320
instead of getting that minimum 60 grams

681
00:25:46,470 --> 00:25:44,320
you end up with several hundred grams do

682
00:25:47,830 --> 00:25:46,480
you change how you portion the sample

683
00:25:49,750 --> 00:25:47,840
once you return it to earth you're still

684
00:25:52,149 --> 00:25:49,760
going to set 75 percent aside or will

685
00:25:53,750 --> 00:25:52,159
you set aside more or less of that for

686
00:25:55,510 --> 00:25:53,760
future study if you end up with much

687
00:25:57,510 --> 00:25:55,520
more than 60

688
00:25:59,430 --> 00:25:57,520

our agreement right now is for 25 for

689
00:26:01,269 --> 00:25:59,440
the science team and 75 for future

690
00:26:03,830 --> 00:26:01,279
generations so

691
00:26:06,390 --> 00:26:03,840
yeah we also have a is it four percent

692
00:26:09,350 --> 00:26:06,400
that's going to the canadians

693
00:26:11,110 --> 00:26:09,360
and 0.5 percent it's going to jaxa we

694
00:26:13,190 --> 00:26:11,120
have an agreement with the hayabusa 2

695
00:26:15,830 --> 00:26:13,200
mission as well right now so

696
00:26:27,669 --> 00:26:16,710
okay

697
00:26:29,350 --> 00:26:27,679
and so now this question um comes from a

698
00:26:31,269 --> 00:26:29,360
cjstuben9

699
00:26:33,029 --> 00:26:31,279
and uh they want to know what

700
00:26:36,310 --> 00:26:33,039
instruments will be used to measure the

701
00:26:38,470 --> 00:26:36,320
rokoski effect on bennu and how

702
00:26:40,390 --> 00:26:38,480
okay so i can take this one so we heard

703
00:26:43,510 --> 00:26:40,400
a little bit about the yarkovsky effect

704
00:26:45,510 --> 00:26:43,520
uh in the in the last press briefing and

705
00:26:47,750 --> 00:26:45,520
this is uh that small

706
00:26:49,590 --> 00:26:47,760
force that causes uh the orbit of the

707
00:26:53,269 --> 00:26:49,600
asteroid to change in a way that's

708
00:26:55,669 --> 00:26:53,279
difficult to predict and this comes from

709
00:26:56,870 --> 00:26:55,679
sunlight basically turning the asteroid

710
00:26:59,269 --> 00:26:56,880
into

711
00:27:01,350 --> 00:26:59,279
something with small solar solar sails

712
00:27:02,310 --> 00:27:01,360
is a way to think about it

713
00:27:04,310 --> 00:27:02,320

and so

714
00:27:06,390 --> 00:27:04,320
we have two

715
00:27:08,630 --> 00:27:06,400
two antennas on the spacecraft we have a

716
00:27:10,789 --> 00:27:08,640
high gain and low gain antenna and we

717
00:27:12,070 --> 00:27:10,799
will use those to track the position of

718
00:27:14,310 --> 00:27:12,080
the asteroid

719
00:27:17,430 --> 00:27:14,320
as we're flying in formation with it and

720
00:27:20,389 --> 00:27:17,440
so any uh any deviation any small

721
00:27:23,350 --> 00:27:20,399
changes from what we anticipate

722
00:27:25,909 --> 00:27:23,360
the orbit of bennu to be versus

723
00:27:27,990 --> 00:27:25,919
what we're tracking will be used to

724
00:27:31,590 --> 00:27:28,000
to measure that that small yarkovsky

725
00:27:35,510 --> 00:27:34,230
hi uh jared hayworth for we report space

726
00:27:36,789 --> 00:27:35,520
i had a question

727
00:27:38,549 --> 00:27:36,799
what's the ultimate fate of the

728
00:27:40,870 --> 00:27:38,559
spacecraft after the sample return

729
00:27:42,389 --> 00:27:40,880
canister has been detached and sent home

730
00:27:44,070 --> 00:27:42,399
so the the spacecraft goes into

731
00:27:46,070 --> 00:27:44,080
heliocentric orbits

732
00:27:47,269 --> 00:27:46,080
after the the src

733
00:27:50,630 --> 00:27:47,279
goes to earth

734
00:27:52,310 --> 00:27:50,640
and remains in orbit um

735
00:27:54,950 --> 00:27:52,320
and could be a very healthy spacecraft

736
00:27:57,590 --> 00:27:54,960
could be an asset should nasa uh wish to

737
00:28:01,029 --> 00:27:57,600
use that but after after that point the

738
00:28:02,950 --> 00:28:01,039

osiris-rex mission uh ceases operations

739
00:28:04,389 --> 00:28:02,960
with the spacecraft

740
00:28:06,710 --> 00:28:04,399
okay we're going to go to this side of

741
00:28:08,549 --> 00:28:06,720
the room

742
00:28:11,190 --> 00:28:08,559
thanks james dean flora today a couple

743
00:28:13,110 --> 00:28:11,200
questions um

744
00:28:14,389 --> 00:28:13,120
first uh you know i've heard the first

745
00:28:17,510 --> 00:28:14,399
u.s sampling mission we've heard

746
00:28:18,549 --> 00:28:17,520
reference to phil i and hayabusa apollo

747
00:28:21,269 --> 00:28:18,559
i just wonder if you could you know kind

748
00:28:22,389 --> 00:28:21,279
of put clearly in context how unique or

749
00:28:24,630 --> 00:28:22,399
rare

750
00:28:26,870 --> 00:28:24,640
of a mission of an event is this to not

751
00:28:28,789 --> 00:28:26,880
only you know to first to touch

752
00:28:30,630 --> 00:28:28,799
an object like that

753
00:28:32,789 --> 00:28:30,640
and and bring the sample home and

754
00:28:34,710 --> 00:28:32,799
um secondly i was just wondering if you

755
00:28:37,190 --> 00:28:34,720
know regarding whatever sample you get

756
00:28:40,149 --> 00:28:37,200
you know i know you're carefully gonna

757
00:28:41,669 --> 00:28:40,159
pick the right spot but is there any

758
00:28:43,510 --> 00:28:41,679
outcome that would could be kind of

759
00:28:44,630 --> 00:28:43,520
disappointing if it doesn't contain you

760
00:28:46,870 --> 00:28:44,640
know certain compounds that you're

761
00:28:49,590 --> 00:28:46,880
hoping to find that would leave

762
00:28:51,269 --> 00:28:49,600
questions more open about origins or or

763
00:28:53,190 --> 00:28:51,279

is anything a good a good sample i'm

764
00:28:54,549 --> 00:28:53,200
gonna quickly answer the second one

765
00:28:56,549 --> 00:28:54,559
which is

766
00:28:58,070 --> 00:28:56,559
i think that anytime we get a surprise

767
00:29:00,230 --> 00:28:58,080
it leads to more questions and that's

768
00:29:01,830 --> 00:29:00,240
fantastic as a scientist you can't help

769
00:29:03,430 --> 00:29:01,840
but want to have more questions in the

770
00:29:05,510 --> 00:29:03,440
end so

771
00:29:07,990 --> 00:29:05,520
one of the great things about exploring

772
00:29:10,070 --> 00:29:08,000
and about going to a really an unknown

773
00:29:10,870 --> 00:29:10,080
place is that you get to learn something

774
00:29:12,950 --> 00:29:10,880
new

775
00:29:14,230 --> 00:29:12,960
so i think that we're fairly confident

776
00:29:16,470 --> 00:29:14,240
that we know this is going to it's

777
00:29:17,590 --> 00:29:16,480
carbon rich asteroid we're we're fairly

778
00:29:19,029 --> 00:29:17,600
confident that there's going to be some

779
00:29:20,950 --> 00:29:19,039
of these organic compounds there but

780
00:29:22,630 --> 00:29:20,960
until we get it back down to

781
00:29:24,630 --> 00:29:22,640
earth you know we won't have those

782
00:29:28,230 --> 00:29:24,640
definitive answers and so we're looking

783
00:29:29,830 --> 00:29:28,240
forward to that in terms of context with

784
00:29:32,389 --> 00:29:29,840
other nations jason do you want to take

785
00:29:34,230 --> 00:29:32,399
that or sure um yeah so again we have

786
00:29:36,630 --> 00:29:34,240
multiple lines of evidence that tell us

787
00:29:38,070 --> 00:29:36,640
this is a carbon-rich asteroid but if it

788
00:29:39,590 --> 00:29:38,080

isn't

789
00:29:41,669 --> 00:29:39,600
that means that we have to we have to

790
00:29:43,269 --> 00:29:41,679
rewrite the textbooks on how we

791
00:29:46,149 --> 00:29:43,279
understand those lines of evidence and

792
00:29:48,149 --> 00:29:46,159
that's exciting too um so

793
00:29:51,110 --> 00:29:48,159
but as far as learning from other

794
00:29:52,070 --> 00:29:51,120
missions uh we draw the spacecraft from

795
00:29:55,350 --> 00:29:52,080
um

796
00:29:59,029 --> 00:29:55,360
uh the juna and juno and maven heritage

797
00:30:02,950 --> 00:29:59,039
uh we've learned a lot from nir's

798
00:30:04,549 --> 00:30:02,960
encounters with asteroid eros

799
00:30:07,190 --> 00:30:04,559
we have uh

800
00:30:09,350 --> 00:30:07,200
exchanged information with jaxa on

801
00:30:11,590 --> 00:30:09,360
hayabusa operations

802
00:30:13,909 --> 00:30:11,600
we've exchanged team members with jaxa

803
00:30:17,269 --> 00:30:13,919
for hayabusa2 operations and we work

804
00:30:19,430 --> 00:30:17,279
closely with esa for rosetta operations

805
00:30:21,510 --> 00:30:19,440
to learn how to operate around

806
00:30:23,830 --> 00:30:21,520
a small object

807
00:30:25,110 --> 00:30:23,840
understand the thermal properties of of

808
00:30:27,110 --> 00:30:25,120
asteroids

809
00:30:28,710 --> 00:30:27,120
uh and try and get every piece of

810
00:30:31,350 --> 00:30:28,720
information we can

811
00:30:32,470 --> 00:30:31,360
uh to understand this strange

812
00:30:34,630 --> 00:30:32,480
environment

813
00:30:37,590 --> 00:30:34,640

and use as much engineering logic as we

814
00:30:39,350 --> 00:30:37,600
can from as i said these other missions

815
00:30:41,430 --> 00:30:39,360
as well as of course stardust

816
00:30:43,590 --> 00:30:41,440
uh on how to bring a sample back from

817
00:30:46,470 --> 00:30:43,600
space

818
00:30:51,190 --> 00:30:49,590
hi i'm stacy severn star talk radio just

819
00:30:53,430 --> 00:30:51,200
a question um we keep hearing about the

820
00:30:55,269 --> 00:30:53,440
carbon richness and i wondered if there

821
00:30:57,509 --> 00:30:55,279
were any other objects that we know of

822
00:30:59,509 --> 00:30:57,519
that are as carbon rich that we might

823
00:31:01,110 --> 00:30:59,519
think of studying was it just the

824
00:31:05,669 --> 00:31:01,120
trajectory and the orbit of this that

825
00:31:09,430 --> 00:31:06,870
um so

826
00:31:11,509 --> 00:31:09,440
we we heard earlier um during the the

827
00:31:13,990 --> 00:31:11,519
last press briefing about the small

828
00:31:16,389 --> 00:31:14,000
handful of objects that were suitable uh

829
00:31:18,870 --> 00:31:16,399
both because they had favor favorable

830
00:31:20,310 --> 00:31:18,880
orbital characteristics but also because

831
00:31:22,870 --> 00:31:20,320
these asteroids had the right

832
00:31:23,990 --> 00:31:22,880
composition this this carbon-rich

833
00:31:26,870 --> 00:31:24,000
material

834
00:31:31,269 --> 00:31:26,880
so actually another great candidate

835
00:31:33,590 --> 00:31:31,279
was an object called ju3 and that is

836
00:31:37,830 --> 00:31:33,600
coincidentally the object that hayabusa

837
00:31:39,830 --> 00:31:37,840
ii uh the jaxa japanese space agency um

838
00:31:42,549 --> 00:31:39,840

that that's become their target asteroid

839
00:31:45,350 --> 00:31:42,559
for sample return so there are a small

840
00:31:48,470 --> 00:31:45,360
handful of objects in the solar system

841
00:31:49,990 --> 00:31:48,480
and in fact in near-earth space that did

842
00:31:51,909 --> 00:31:50,000
have the right characteristics but

843
00:31:53,509 --> 00:31:51,919
ultimately venue was so well

844
00:31:55,750 --> 00:31:53,519
characterized that we

845
00:31:57,509 --> 00:31:55,760
we wanted to go there because we already

846
00:32:00,950 --> 00:31:57,519
had enough data to help us start

847
00:32:02,310 --> 00:32:00,960
mitigating risk

848
00:32:06,070 --> 00:32:02,320
okay we're going to go back to the phone

849
00:32:11,509 --> 00:32:08,710
mark gotch do you have a question yes uh

850
00:32:12,789 --> 00:32:11,519
mark gotch historical aerospace news

851
00:32:15,509 --> 00:32:12,799
another question

852
00:32:18,149 --> 00:32:15,519
once the osiris met rex mission has been

853
00:32:22,470 --> 00:32:18,159
launched the rocket going forward

854
00:32:25,909 --> 00:32:22,480
once the uh final stage has gone through

855
00:32:27,669 --> 00:32:25,919
and the spacecraft enters into space the

856
00:32:30,310 --> 00:32:27,679
fairing has been shed

857
00:32:33,509 --> 00:32:30,320
it going forward what is the distance

858
00:32:34,549 --> 00:32:33,519
from the the planet earth to

859
00:32:35,509 --> 00:32:34,559
bennu

860
00:32:37,350 --> 00:32:35,519
and

861
00:32:40,230 --> 00:32:37,360
will it be traveling it will be

862
00:32:42,870 --> 00:32:40,240
traveling on rocket fuel going forward

863
00:32:45,750 --> 00:32:42,880

on that distance can you also tell me

864
00:32:47,990 --> 00:32:45,760
how solar power will play into this

865
00:32:49,909 --> 00:32:48,000
mission

866
00:32:52,310 --> 00:32:49,919
i can answer some of those for you off

867
00:32:55,269 --> 00:32:52,320
off of my head uh so the the the

868
00:32:57,590 --> 00:32:55,279
majority of the uh of the push we get is

869
00:32:59,509 --> 00:32:57,600
from the launch vehicle from the booster

870
00:33:00,470 --> 00:32:59,519
and from the centaur the center gives us

871
00:33:03,110 --> 00:33:00,480
most of the

872
00:33:04,789 --> 00:33:03,120
of the the push we need to get to bennu

873
00:33:07,590 --> 00:33:04,799
the centaur itself goes into

874
00:33:10,230 --> 00:33:07,600
heliocentric orbit uh becoming another

875
00:33:12,710 --> 00:33:10,240
pseudo-asteroid if you wish

876
00:33:15,909 --> 00:33:12,720
the the spacecraft uses uh hydrazine

877
00:33:19,269 --> 00:33:15,919
mono propellant and we undergo a deep

878
00:33:20,549 --> 00:33:19,279
deep space maneuver uh in january of

879
00:33:23,110 --> 00:33:20,559
next year

880
00:33:24,549 --> 00:33:23,120
followed by the earth gravity assist

881
00:33:26,950 --> 00:33:24,559
a year from now to put us in the same

882
00:33:29,990 --> 00:33:26,960
plane as bennu

883
00:33:31,269 --> 00:33:30,000
the solar arrays are used to power our

884
00:33:34,549 --> 00:33:31,279
electronics

885
00:33:36,310 --> 00:33:34,559
it's not a solar electric spacecraft so

886
00:33:38,389 --> 00:33:36,320
again a monoprop we have

887
00:33:40,389 --> 00:33:38,399
both the main thrusters and a large

888
00:33:42,950 --> 00:33:40,399

number of other thrusters for very fine

889
00:33:46,070 --> 00:33:42,960
maneuvering around such a small object

890
00:33:47,590 --> 00:33:46,080
uh but we have uh plenty of power margin

891
00:33:50,549 --> 00:33:47,600
uh uh

892
00:33:52,230 --> 00:33:50,559
depending on where we are uh

893
00:33:54,230 --> 00:33:52,240
either closer to the sun or further from

894
00:33:55,590 --> 00:33:54,240
the sun because bennu is on is on an

895
00:33:57,909 --> 00:33:55,600
elliptical orbit

896
00:33:59,669 --> 00:33:57,919
um benny was chasing the earth right now

897
00:34:02,470 --> 00:33:59,679
and will soon catch up but i don't

898
00:34:04,549 --> 00:34:02,480
recall the distance today i believe the

899
00:34:06,230 --> 00:34:04,559
total distance of this mission that it

900
00:34:07,830 --> 00:34:06,240
will have traveled is four and a half

901
00:34:09,669 --> 00:34:07,840
billion miles

902
00:34:11,750 --> 00:34:09,679
so it's got it's got a ways to go but

903
00:34:13,030 --> 00:34:11,760
we're really excited about that

904
00:34:14,790 --> 00:34:13,040
yeah

905
00:34:16,389 --> 00:34:14,800
okay we're gonna take one more question

906
00:34:18,149 --> 00:34:16,399
from social media and then we're gonna

907
00:34:20,950 --> 00:34:18,159
wrap up

908
00:34:24,230 --> 00:34:20,960
okay this question is from uh

909
00:34:26,030 --> 00:34:24,240
cranati um and the question is uh does

910
00:34:28,149 --> 00:34:26,040
nasa have a

911
00:34:30,629 --> 00:34:28,159
osiris-rex twin

912
00:34:31,909 --> 00:34:30,639
like the mars rovers do

913
00:34:33,589 --> 00:34:31,919

i think that question's for jason

914
00:34:34,950 --> 00:34:33,599
because you know we have a lab at

915
00:34:35,829 --> 00:34:34,960
goddard

916
00:34:38,550 --> 00:34:35,839
um

917
00:34:41,909 --> 00:34:38,560
i used to joke that ideally we would

918
00:34:44,629 --> 00:34:41,919
launch two identical spacecraft uh one

919
00:34:46,869 --> 00:34:44,639
collect the sample and one be a blank

920
00:34:49,430 --> 00:34:46,879
to do a proper double-blind study when

921
00:34:51,109 --> 00:34:49,440
the sample comes back

922
00:34:52,550 --> 00:34:51,119
that's really how to do the mission

923
00:34:54,790 --> 00:34:52,560
right but

924
00:34:56,790 --> 00:34:54,800
no one would believe me and and that um

925
00:34:58,790 --> 00:34:56,800
that would drive our costs considerably

926
00:35:00,710 --> 00:34:58,800
like i said scientists want always want

927
00:35:02,790 --> 00:35:00,720
more

928
00:35:04,069 --> 00:35:02,800
there we built one spacecraft and we

929
00:35:06,870 --> 00:35:04,079
built it right

930
00:35:09,109 --> 00:35:06,880
uh we have this is a piled cost cap

931
00:35:11,109 --> 00:35:09,119
mission and we built within that cost

932
00:35:13,349 --> 00:35:11,119
and there's not margin to build a second

933
00:35:15,030 --> 00:35:13,359
just-in-case spacecraft

934
00:35:16,390 --> 00:35:15,040
no matter how much i want one yeah that

935
00:35:18,230 --> 00:35:16,400
being said we're going to use the

936
00:35:20,069 --> 00:35:18,240
technology that was used here to develop

937
00:35:22,310 --> 00:35:20,079
further missions in the future so we

938
00:35:24,230 --> 00:35:22,320

look forward to potential future

939
00:35:25,510 --> 00:35:24,240
missions you know nasa is still here

940
00:35:27,109 --> 00:35:25,520
it's alive and strong so we're going to

941
00:35:29,270 --> 00:35:27,119
keep on going

942
00:35:31,829 --> 00:35:29,280
okay all right great thank you christina