
LUCY IN THE SKY WITH ASTEROIDS
NASA SCIENCE LIVE
VIRTUAL EDITION

1
00:00:00,530 --> 00:00:10,709
[Music]

2
00:00:15,990 --> 00:00:13,430
comets and asteroids are truly the time

3
00:00:18,710 --> 00:00:16,000
capsules of our galaxy with many of them

4
00:00:21,429 --> 00:00:18,720
dating back to more than 4 billion years

5
00:00:23,750 --> 00:00:21,439
ago these prehistoric treasures hold the

6
00:00:26,870 --> 00:00:23,760
lost tales about the origins of our

7
00:00:29,109 --> 00:00:26,880
solar system and luckily we are slowly

8
00:00:31,830 --> 00:00:29,119
starting to unravel its story

9
00:00:34,630 --> 00:00:31,840
missions like nasa's osiris-rex and jack

10
00:00:36,870 --> 00:00:34,640
says hybus hivasua ii are providing

11
00:00:40,069 --> 00:00:36,880
insight into the history of our solar

12
00:00:43,110 --> 00:00:40,079
system and even how life began on earth

13
00:00:45,590 --> 00:00:43,120

so what's next hello and welcome to

14
00:00:48,389 --> 00:00:45,600
another virtual episode of nasa science

15
00:00:50,630 --> 00:00:48,399
live i'm your host tahira allen and

16
00:00:53,750 --> 00:00:50,640
today we're talking all about one of

17
00:00:56,229 --> 00:00:53,760
nasa's upcoming asteroid missions lucy

18
00:00:58,790 --> 00:00:56,239
the first spacecraft to study the trojan

19
00:01:01,349 --> 00:00:58,800
asteroids which orbit the sun in two

20
00:01:03,110 --> 00:01:01,359
groups one in front of jupiter's path

21
00:01:05,830 --> 00:01:03,120
and the other behind it

22
00:01:08,390 --> 00:01:05,840
once launched in october 2021 the

23
00:01:10,710 --> 00:01:08,400
mission will complete a 12-year journey

24
00:01:13,590 --> 00:01:10,720
to seven different trojan asteroids that

25
00:01:16,550 --> 00:01:13,600
may hold vital clues to deciphering the

26
00:01:18,870 --> 00:01:16,560
history of our solar system but before

27
00:01:24,810 --> 00:01:18,880
we get started let's take a deeper look

28
00:02:59,509 --> 00:01:57,210
[Music]

29
00:03:03,270 --> 00:03:01,270
great so now that we learned a little

30
00:03:05,430 --> 00:03:03,280
bit more about this exciting mission

31
00:03:08,070 --> 00:03:05,440
let's talk to some of the experts behind

32
00:03:11,509 --> 00:03:08,080
it i am thrilled to be joined today by

33
00:03:13,270 --> 00:03:11,519
dr adriana ocampo lucy program executive

34
00:03:15,990 --> 00:03:13,280
at nasa headquarters

35
00:03:18,149 --> 00:03:16,000
dr kathy olkan deputy principal

36
00:03:21,350 --> 00:03:18,159
investigator for southwest research

37
00:03:23,990 --> 00:03:21,360
institute and jessica thompson project

38
00:03:25,830 --> 00:03:24,000

systems engineer at nasa goddard ladies

39
00:03:28,309 --> 00:03:25,840
thank you all so much for being here

40
00:03:30,229 --> 00:03:28,319
today and to kick things off could you

41
00:03:33,710 --> 00:03:30,239
help us understand a little bit more

42
00:03:36,869 --> 00:03:33,720
about what a trojan asteroid is

43
00:03:37,750 --> 00:03:36,879
yes thank you for that question

44
00:03:40,949 --> 00:03:37,760
um

45
00:03:43,670 --> 00:03:40,959
let's see if we go back in time to a

46
00:03:45,830 --> 00:03:43,680
point about four and a half billion

47
00:03:48,710 --> 00:03:45,840
years ago

48
00:03:51,110 --> 00:03:48,720
when the early solar system was

49
00:03:54,070 --> 00:03:51,120
could have seen a dense cloud

50
00:03:55,190 --> 00:03:54,080
interstellar dust then this dust would

51
00:03:58,710 --> 00:03:55,200
have

52
00:04:01,589 --> 00:03:58,720
collapsed and formed the solar nebula

53
00:04:03,190 --> 00:04:01,599
which started to speak ensure by the

54
00:04:06,070 --> 00:04:03,200
gravitational force

55
00:04:08,309 --> 00:04:06,080
and that is what grabbed that material

56
00:04:11,270 --> 00:04:08,319
and started forming the

57
00:04:15,190 --> 00:04:11,280
the early planet solar system

58
00:04:16,390 --> 00:04:15,200
and the trojans are really the remnant

59
00:04:20,310 --> 00:04:16,400
of that

60
00:04:25,030 --> 00:04:20,320
planetary formation process that form

61
00:04:26,870 --> 00:04:25,040
planets like jupiter's saturn action and

62
00:04:30,310 --> 00:04:26,880
venus

63
00:04:32,310 --> 00:04:30,320

we are very excited that uh

64
00:04:34,790 --> 00:04:32,320
for the first time we're going to go and

65
00:04:37,749 --> 00:04:34,800
explore a solar system

66
00:04:40,230 --> 00:04:37,759
uh with a loose emission in this epic

67
00:04:42,550 --> 00:04:40,240
voyage of 12 years

68
00:04:45,110 --> 00:04:42,560
and the lunch countdown has already

69
00:04:45,909 --> 00:04:45,120
started we are only at 10

70
00:04:48,790 --> 00:04:45,919
um

71
00:04:55,189 --> 00:04:48,800
10 months and 12 days from the opening

72
00:05:00,550 --> 00:04:57,749
there are thousands of asteroids out

73
00:05:03,189 --> 00:05:00,560
there and lucy will fly by them between

74
00:05:05,430 --> 00:05:03,199
300 and 600 miles away

75
00:05:07,430 --> 00:05:05,440
allowing us a close-up view of all the

76
00:05:10,230 --> 00:05:07,440
detail on the surface

77
00:05:12,070 --> 00:05:10,240
these asteroids are in a unique position

78
00:05:14,550 --> 00:05:12,080
in that they are clustered in jupiter's

79
00:05:16,310 --> 00:05:14,560
orbit at the lagrange points

80
00:05:18,629 --> 00:05:16,320
lagrange points are places in space

81
00:05:20,870 --> 00:05:18,639
where objects tend to stay put due to

82
00:05:22,469 --> 00:05:20,880
the gravitational pull of two large

83
00:05:24,710 --> 00:05:22,479
masses nearby

84
00:05:26,469 --> 00:05:24,720
the forces on these small bodies put

85
00:05:28,070 --> 00:05:26,479
them in equilibrium

86
00:05:30,790 --> 00:05:28,080
meaning they're trapped in place

87
00:05:34,550 --> 00:05:30,800
allowing lucy to fly to them and image

88
00:05:39,510 --> 00:05:37,350

and one of the really intriguing aspects

89
00:05:41,430 --> 00:05:39,520
of the trojan asteroids is that they're

90
00:05:43,590 --> 00:05:41,440
a diverse population

91
00:05:46,310 --> 00:05:43,600
from astronomical observations they

92
00:05:48,390 --> 00:05:46,320
appear to be just a point of light but

93
00:05:49,350 --> 00:05:48,400
that's enough information so that we can

94
00:05:51,590 --> 00:05:49,360
see

95
00:05:54,310 --> 00:05:51,600
some of the surface properties like

96
00:05:56,629 --> 00:05:54,320
color and surface composition and we can

97
00:05:58,550 --> 00:05:56,639
see that there's a wide range some

98
00:06:00,710 --> 00:05:58,560
trojan asteroids are more red than

99
00:06:03,430 --> 00:06:00,720
others for example

100
00:06:05,749 --> 00:06:03,440
and this is an image of two of our

101
00:06:09,029 --> 00:06:05,759
trojan targets that lucy will go and

102
00:06:10,710 --> 00:06:09,039
visit this is patroclus and menacious

103
00:06:13,590 --> 00:06:10,720
this image was taken with the hubble

104
00:06:15,590 --> 00:06:13,600
space telescope and these targets are

105
00:06:17,670 --> 00:06:15,600
really interesting because

106
00:06:20,629 --> 00:06:17,680
they are a binary system and they're

107
00:06:25,029 --> 00:06:20,639
about the same size so they orbit a

108
00:06:29,510 --> 00:06:26,950
wow so what we already know is

109
00:06:31,189 --> 00:06:29,520
fascinating and i'm wondering why is it

110
00:06:33,430 --> 00:06:31,199
important for a mission like lucy to

111
00:06:35,110 --> 00:06:33,440
study them

112
00:06:37,430 --> 00:06:35,120
well the diversity of the trojan

113
00:06:41,110 --> 00:06:37,440

asteroids is a clue that they really had

114
00:06:43,270 --> 00:06:41,120
a very interesting history if they were

115
00:06:45,270 --> 00:06:43,280
formed in the location we find them in

116
00:06:47,510 --> 00:06:45,280
today we would have expected a much more

117
00:06:48,469 --> 00:06:47,520
uniform population

118
00:06:50,950 --> 00:06:48,479
but

119
00:06:52,950 --> 00:06:50,960
we don't see that and there's some

120
00:06:55,670 --> 00:06:52,960
current theories of

121
00:06:57,909 --> 00:06:55,680
uh modern solar modern theories of solar

122
00:06:59,830 --> 00:06:57,919
system formation that involve the

123
00:07:02,390 --> 00:06:59,840
migration of

124
00:07:05,110 --> 00:07:02,400
giant planets away from the sun and this

125
00:07:07,510 --> 00:07:05,120
causes a chaotic disruption of the small

126
00:07:09,510 --> 00:07:07,520
bodies in the solar system

127
00:07:11,430 --> 00:07:09,520
and we believe that this caused some of

128
00:07:14,950 --> 00:07:11,440
these bodies to be ejected from our

129
00:07:16,870 --> 00:07:14,960
solar system and others to be trapped in

130
00:07:19,990 --> 00:07:16,880
these lagrange points

131
00:07:22,150 --> 00:07:20,000
forming the trojan asteroids that we see

132
00:07:24,550 --> 00:07:22,160
and for these reasons over the course of

133
00:07:28,830 --> 00:07:24,560
12 years we're going to visit seven

134
00:07:33,749 --> 00:07:31,350
spacecraft so to add to

135
00:07:36,710 --> 00:07:33,759
what kathy just mentioned

136
00:07:39,029 --> 00:07:36,720
um you know one of the key questions

137
00:07:41,589 --> 00:07:39,039
that we have in planetary science is

138
00:07:45,270 --> 00:07:41,599

what is the molecule of water and the

139
00:07:48,390 --> 00:07:45,280
organic material that sparked the life

140
00:07:51,350 --> 00:07:48,400
as knowledge in our planet came from

141
00:07:53,909 --> 00:07:51,360
and asteroids hold the key to these

142
00:07:56,550 --> 00:07:53,919
questions and by studying the trojan

143
00:07:59,430 --> 00:07:56,560
asteroids the loose emission will shed

144
00:08:01,510 --> 00:07:59,440
light to this enigmatic

145
00:08:04,390 --> 00:08:01,520
question on how

146
00:08:07,110 --> 00:08:04,400
life may have arrived to earth

147
00:08:10,230 --> 00:08:07,120
lucy will not only investigate the

148
00:08:12,309 --> 00:08:10,240
trojan asteroids composition but it will

149
00:08:16,230 --> 00:08:12,319
also

150
00:08:19,589 --> 00:08:16,240
be able to inform the relative age and

151
00:08:21,589 --> 00:08:19,599
the chronology on how the processes

152
00:08:24,230 --> 00:08:21,599
happen in the formation of the solar

153
00:08:30,150 --> 00:08:26,950
wow i mean this is all super incredible

154
00:08:33,509 --> 00:08:30,160
and so jessica i actually heard that the

155
00:08:34,630 --> 00:08:33,519
name lucy has a tie to the beatles um

156
00:08:37,350 --> 00:08:34,640
and i was wondering if you could

157
00:08:40,790 --> 00:08:37,360
elaborate on that

158
00:08:43,190 --> 00:08:40,800
yeah it absolutely does lucy is named

159
00:08:45,590 --> 00:08:43,200
after the hominin skeleton fossil that

160
00:08:47,030 --> 00:08:45,600
was discovered in ethiopia by donald

161
00:08:49,670 --> 00:08:47,040
johansen

162
00:08:52,790 --> 00:08:49,680
and upon discovering this skeleton

163
00:08:54,870 --> 00:08:52,800

the team celebrated looking to the stars

164
00:08:56,550 --> 00:08:54,880
while playing the beatles song lucy in

165
00:08:59,030 --> 00:08:56,560
the sky with diamonds

166
00:09:00,790 --> 00:08:59,040
which led to the name of the fossil

167
00:09:02,870 --> 00:09:00,800
and just like the discovery of this

168
00:09:05,590 --> 00:09:02,880
skeleton taught us about the origins of

169
00:09:07,590 --> 00:09:05,600
humanity the lucy asteroid mission will

170
00:09:10,470 --> 00:09:07,600
teach us about the origins of the solar

171
00:09:15,990 --> 00:09:13,509
well i mean lucy has a very big task at

172
00:09:18,550 --> 00:09:16,000
hand it sounds like and i'm wondering

173
00:09:22,389 --> 00:09:18,560
what are some of the instruments that um

174
00:09:23,990 --> 00:09:22,399
the mission has to complete this

175
00:09:25,590 --> 00:09:24,000
that's a great question

176
00:09:27,670 --> 00:09:25,600
so although we can't see the

177
00:09:30,550 --> 00:09:27,680
characteristics of the trojans very well

178
00:09:32,870 --> 00:09:30,560
from the ground lucy has five cameras on

179
00:09:35,190 --> 00:09:32,880
board that will capture close-up images

180
00:09:36,790 --> 00:09:35,200
in different wavelengths the lorry

181
00:09:38,389 --> 00:09:36,800
instrument will take pictures in the

182
00:09:40,470 --> 00:09:38,399
visible spectrum

183
00:09:42,150 --> 00:09:40,480
similar to your iphone camera but more

184
00:09:43,590 --> 00:09:42,160
sophisticated

185
00:09:45,990 --> 00:09:43,600
which will allow this mission to be able

186
00:09:47,750 --> 00:09:46,000
to get a great view of the geology of

187
00:09:50,470 --> 00:09:47,760
the surface

188
00:09:51,350 --> 00:09:50,480

lucy also has a thermal camera named

189
00:09:52,870 --> 00:09:51,360
tess

190
00:09:55,190 --> 00:09:52,880
that will take pictures of the

191
00:09:58,389 --> 00:09:55,200
temperature on the surface similar to

192
00:10:01,110 --> 00:09:58,399
seeing a body heat picture of yourself

193
00:10:04,069 --> 00:10:01,120
and our third camera is kind of a two in

194
00:10:07,030 --> 00:10:04,079
one camera called ralph which takes

195
00:10:09,430 --> 00:10:07,040
infrared and visible color images by

196
00:10:14,310 --> 00:10:09,440
scanning the surface of each asteroid as

197
00:10:18,949 --> 00:10:16,470
and also we have a

198
00:10:20,710 --> 00:10:18,959
very interesting experiment

199
00:10:23,030 --> 00:10:20,720
on board the

200
00:10:25,430 --> 00:10:23,040
the spacecraft that we call the gravity

201
00:10:27,910 --> 00:10:25,440
experiment we actually use

202
00:10:31,350 --> 00:10:27,920
the hygiene antenna that you can see

203
00:10:33,509 --> 00:10:31,360
here the encircle the circle in silver

204
00:10:36,069 --> 00:10:33,519
and this is in a collaboration with the

205
00:10:37,350 --> 00:10:36,079
germany german space

206
00:10:39,670 --> 00:10:37,360
agency

207
00:10:42,230 --> 00:10:39,680
uh and these the gravity experiments

208
00:10:44,069 --> 00:10:42,240
will help us determine the mass of the

209
00:10:47,910 --> 00:10:44,079
trojan

210
00:10:48,870 --> 00:10:47,920
asteroids as the lucid spacecraft fly by

211
00:10:50,870 --> 00:10:48,880
them

212
00:10:53,269 --> 00:10:50,880
this is a very sensitive

213
00:10:54,790 --> 00:10:53,279

experiment that will

214
00:10:56,310 --> 00:10:54,800
enable

215
00:10:58,230 --> 00:10:56,320
to determine

216
00:11:01,670 --> 00:10:58,240
any deviation on the spacecraft

217
00:11:03,030 --> 00:11:01,680
trajectory as it flies by the trojan

218
00:11:03,910 --> 00:11:03,040
asteroids

219
00:11:07,590 --> 00:11:03,920
and

220
00:11:10,069 --> 00:11:07,600
in that way will determine the mass of

221
00:11:12,630 --> 00:11:10,079
or or the amount of matter that there is

222
00:11:15,190 --> 00:11:12,640
in these objects and from there their

223
00:11:17,590 --> 00:11:15,200
density

224
00:11:19,750 --> 00:11:17,600
and we also have two terminal tracking

225
00:11:21,350 --> 00:11:19,760
cameras on board these are part of the

226
00:11:23,509 --> 00:11:21,360
guidance and control system of the

227
00:11:26,069 --> 00:11:23,519
spacecraft but we'll be able to use

228
00:11:27,910 --> 00:11:26,079
these cameras to collect wide field of

229
00:11:30,389 --> 00:11:27,920
view images

230
00:11:33,430 --> 00:11:30,399
as we fly past you can see them at the

231
00:11:35,829 --> 00:11:33,440
top of this graphic this is our

232
00:11:38,389 --> 00:11:35,839
instrument pointing platform

233
00:11:41,269 --> 00:11:38,399
where our cameras reside and it's the

234
00:11:42,389 --> 00:11:41,279
two small objects round objects at the

235
00:11:45,030 --> 00:11:42,399
top

236
00:11:48,069 --> 00:11:45,040
and we will use these

237
00:11:51,750 --> 00:11:48,079
uh cameras to be able to get the volume

238
00:11:52,870 --> 00:11:51,760

of the trojan asteroids through imaging

239
00:11:57,829 --> 00:11:52,880
and

240
00:11:59,990 --> 00:11:57,839
be able to learn about the density of

241
00:12:02,389 --> 00:12:00,000
our trojan asteroids

242
00:12:03,910 --> 00:12:02,399
using all of these instruments together

243
00:12:06,550 --> 00:12:03,920
we're going to be able to investigate

244
00:12:08,949 --> 00:12:06,560
the geology the surface composition

245
00:12:11,430 --> 00:12:08,959
their internal properties and search for

246
00:12:12,629 --> 00:12:11,440
satellites at these trojan asteroids

247
00:12:15,030 --> 00:12:12,639
it's going to be a great first

248
00:12:17,110 --> 00:12:15,040
reconnaissance

249
00:12:19,430 --> 00:12:17,120
wow and this just sounds like a really

250
00:12:22,069 --> 00:12:19,440
complex piece of technology and i'm

251
00:12:24,389 --> 00:12:22,079
wondering how many people work on this

252
00:12:26,550 --> 00:12:24,399
mission

253
00:12:29,829 --> 00:12:26,560
tahira that's a great question there's

254
00:12:31,990 --> 00:12:29,839
approximately 750 people that have been

255
00:12:34,550 --> 00:12:32,000
involved with this lucy mission

256
00:12:35,829 --> 00:12:34,560
lucy family is really a big mix of

257
00:12:38,470 --> 00:12:35,839
engineers

258
00:12:41,030 --> 00:12:38,480
technicians scientists

259
00:12:43,990 --> 00:12:41,040
managers and even interns

260
00:12:45,910 --> 00:12:44,000
our team is truly the key to our success

261
00:12:47,910 --> 00:12:45,920
and it's been very motivating to work

262
00:12:49,430 --> 00:12:47,920
with people from multiple organizations

263
00:12:51,269 --> 00:12:49,440

and universities

264
00:12:53,350 --> 00:12:51,279
and i'll tell you each and every

265
00:12:55,829 --> 00:12:53,360
person's role and experience on this

266
00:12:58,470 --> 00:12:55,839
mission has been vital to designing

267
00:13:01,430 --> 00:12:58,480
building testing and soon to be

268
00:13:03,910 --> 00:13:01,440
launching this spacecraft

269
00:13:06,069 --> 00:13:03,920
wow that is incredible to know that so

270
00:13:08,550 --> 00:13:06,079
many people come together for one

271
00:13:10,550 --> 00:13:08,560
amazing object and but i do want to go

272
00:13:13,030 --> 00:13:10,560
back to an animation earlier in the show

273
00:13:15,190 --> 00:13:13,040
because it looked like there were swarms

274
00:13:17,430 --> 00:13:15,200
of trojan asteroids um in front of

275
00:13:19,430 --> 00:13:17,440
behind jupiter and so i'm wondering if

276
00:13:21,670 --> 00:13:19,440
we were standing on one of the trojan

277
00:13:23,829 --> 00:13:21,680
asteroids would we see many of them

278
00:13:25,670 --> 00:13:23,839
around us

279
00:13:27,910 --> 00:13:25,680
while these green dots look like they're

280
00:13:30,790 --> 00:13:27,920
really close together the animation

281
00:13:32,150 --> 00:13:30,800
doesn't convey how vast and empty space

282
00:13:33,750 --> 00:13:32,160
actually is

283
00:13:36,150 --> 00:13:33,760
it wouldn't look like the millennium

284
00:13:38,069 --> 00:13:36,160
falcon flying through an asteroid belt

285
00:13:40,870 --> 00:13:38,079
dodging asteroids

286
00:13:43,030 --> 00:13:40,880
of the about 5 000 known trojan

287
00:13:45,670 --> 00:13:43,040
asteroids in each swarm they're

288
00:13:48,710 --> 00:13:45,680

separated each separated by about 9

289
00:13:51,750 --> 00:13:48,720
million miles so if we were standing on

290
00:13:54,629 --> 00:13:51,760
a trojan asteroid and looked out at them

291
00:13:56,069 --> 00:13:54,639
at the at the other trojans there we

292
00:13:57,350 --> 00:13:56,079
actually wouldn't be able to see them

293
00:13:59,350 --> 00:13:57,360
with our eye

294
00:14:01,509 --> 00:13:59,360
or at least not many of them because

295
00:14:04,230 --> 00:14:01,519
some of them would be as faint as a 10th

296
00:14:06,470 --> 00:14:04,240
magnitude star

297
00:14:08,629 --> 00:14:06,480
wow okay those movies are very deceiving

298
00:14:11,590 --> 00:14:08,639
uh thank you for putting that input into

299
00:14:13,350 --> 00:14:11,600
perspective for us and so i am seeing a

300
00:14:15,990 --> 00:14:13,360
lot of great questions rolling from

301
00:14:17,509 --> 00:14:16,000
users online and if you are watching now

302
00:14:19,430 --> 00:14:17,519
please don't hesitate to join the

303
00:14:21,110 --> 00:14:19,440
conversation with us submit your

304
00:14:23,030 --> 00:14:21,120
questions in the comment box where

305
00:14:25,910 --> 00:14:23,040
you're viewing from or by using the

306
00:14:28,389 --> 00:14:25,920
hashtag asknasa on social media so

307
00:14:31,110 --> 00:14:28,399
ladies to kick things off i have nope

308
00:14:33,829 --> 00:14:31,120
nope nope on youtube uh jessica i think

309
00:14:36,150 --> 00:14:33,839
this is a good one for you who asks will

310
00:14:38,790 --> 00:14:36,160
lucy be sending data and photos during

311
00:14:44,870 --> 00:14:41,670
yeah great question so lucy has a

312
00:14:47,670 --> 00:14:44,880
two-way light time of about 45 minutes

313
00:14:49,509 --> 00:14:47,680

to send commands and receive data

314
00:14:51,670 --> 00:14:49,519
so we'll have the first images back

315
00:14:54,550 --> 00:14:51,680
within a few hours after flying by the

316
00:14:58,389 --> 00:14:54,560
first asteroid which is your babies will

317
00:15:03,269 --> 00:15:00,550
nice that is so exciting to hear that

318
00:15:04,949 --> 00:15:03,279
they're coming back and so uh kathy i've

319
00:15:06,069 --> 00:15:04,959
got a great one for you

320
00:15:08,629 --> 00:15:06,079
um

321
00:15:11,670 --> 00:15:08,639
sean on youtube asks what is the

322
00:15:14,150 --> 00:15:11,680
composition of a trojan asteroid

323
00:15:15,750 --> 00:15:14,160
well that's a really good question

324
00:15:17,269 --> 00:15:15,760
so um

325
00:15:19,430 --> 00:15:17,279
they

326
00:15:20,870 --> 00:15:19,440
have different spectral types and that's

327
00:15:22,470 --> 00:15:20,880
how we can tell about the surface

328
00:15:23,350 --> 00:15:22,480
composition

329
00:15:25,750 --> 00:15:23,360
and

330
00:15:28,069 --> 00:15:25,760
they look like some of the asteroids in

331
00:15:31,590 --> 00:15:28,079
the asteroid belt we call them uh

332
00:15:33,749 --> 00:15:31,600
there's c d and p type asteroids that

333
00:15:35,509 --> 00:15:33,759
are in the asteroid belt or in the

334
00:15:37,749 --> 00:15:35,519
trojan asteroids

335
00:15:39,189 --> 00:15:37,759
and one thing we really want to know

336
00:15:40,949 --> 00:15:39,199
when we visit

337
00:15:43,990 --> 00:15:40,959
with lucy is

338
00:15:46,150 --> 00:15:44,000

what is the composition is there water

339
00:15:49,110 --> 00:15:46,160
uh near the surface

340
00:15:51,189 --> 00:15:49,120
what other uh what are the densities of

341
00:15:53,189 --> 00:15:51,199
these objects so part of the reason

342
00:15:54,470 --> 00:15:53,199
we're going to visit is really to answer

343
00:15:56,870 --> 00:15:54,480
that question

344
00:15:57,990 --> 00:15:56,880
and from the ground we can see the

345
00:15:59,189 --> 00:15:58,000
overall

346
00:16:02,790 --> 00:15:59,199
uh

347
00:16:05,509 --> 00:16:02,800
composition of the surface but to see

348
00:16:09,509 --> 00:16:05,519
surface details that aren't resolved

349
00:16:10,870 --> 00:16:09,519
will really need to send a spacecraft

350
00:16:13,269 --> 00:16:10,880
so actually kathy i've got a great

351
00:16:15,110 --> 00:16:13,279
follow-up to you so john on facebook

352
00:16:18,629 --> 00:16:15,120
wants to know will we know where the

353
00:16:22,310 --> 00:16:20,310
that's a good question and we're going

354
00:16:23,509 --> 00:16:22,320
to be trying to answer that question and

355
00:16:27,910 --> 00:16:23,519
by looking

356
00:16:33,269 --> 00:16:31,030
stable at further distances from the sun

357
00:16:35,509 --> 00:16:33,279
if we can find those on the trojan

358
00:16:38,470 --> 00:16:35,519
asteroids that's going to be one key

359
00:16:39,189 --> 00:16:38,480
clue to where they had originated

360
00:16:45,749 --> 00:16:39,199
the

361
00:16:47,430 --> 00:16:45,759
is going to be something we're looking

362
00:16:51,189 --> 00:16:47,440
for when we fly by

363
00:16:55,189 --> 00:16:51,199

in starting in 2027

364
00:16:57,269 --> 00:16:55,199
nice okay um adriana uh lori jones on

365
00:16:59,509 --> 00:16:57,279
twitter asks if the lucy mission is

366
00:17:01,670 --> 00:16:59,519
successful and provides good data are

367
00:17:04,150 --> 00:17:01,680
there plans for future missions uh such

368
00:17:07,029 --> 00:17:04,160
as lucy's

369
00:17:09,029 --> 00:17:07,039
yes that's a great question because you

370
00:17:11,510 --> 00:17:09,039
know in planetary exploration what we

371
00:17:13,669 --> 00:17:11,520
have learned is usually we fly by

372
00:17:17,990 --> 00:17:13,679
objects by planets

373
00:17:19,429 --> 00:17:18,000
and then the next step is toward the

374
00:17:23,270 --> 00:17:19,439
object or

375
00:17:27,110 --> 00:17:23,280
and then and then to learn so we did our

376
00:17:30,070 --> 00:17:27,120
planning and uh will be having

377
00:17:33,029 --> 00:17:30,080
calls out for by the scientific

378
00:17:35,830 --> 00:17:33,039
community to propose the follow-up

379
00:17:39,270 --> 00:17:35,840
missions to the lucid mission so a lot

380
00:17:41,510 --> 00:17:39,280
more to come this is just the beginning

381
00:17:43,750 --> 00:17:41,520
so i'm interested to know there was

382
00:17:46,549 --> 00:17:43,760
nasa's osiris-rex mission was recently

383
00:17:52,470 --> 00:17:46,559
in the news for its first tag sample and

384
00:17:52,480 --> 00:17:56,230
so the osiris-rex commission

385
00:18:00,390 --> 00:17:57,990
go ahead kathy yes

386
00:18:01,669 --> 00:18:00,400
thank you adriana uh the

387
00:18:03,990 --> 00:18:01,679
the

388
00:18:06,150 --> 00:18:04,000

nasa has a whole suite of asteroid

389
00:18:09,350 --> 00:18:06,160
missions that work together really

390
00:18:12,630 --> 00:18:09,360
synergistically and osiris-rex is one of

391
00:18:15,510 --> 00:18:12,640
them in the upcoming mission uh psyche

392
00:18:17,350 --> 00:18:15,520
to a metallic asteroid is another and

393
00:18:20,710 --> 00:18:17,360
all of these missions

394
00:18:23,909 --> 00:18:20,720
uh really give us different clues about

395
00:18:26,150 --> 00:18:23,919
the not only uh near-earth asteroids

396
00:18:27,830 --> 00:18:26,160
main belt asteroids but also trojan

397
00:18:29,750 --> 00:18:27,840
asteroids so we can really piece

398
00:18:31,909 --> 00:18:29,760
together uh

399
00:18:35,350 --> 00:18:31,919
how the planets in our solar system

400
00:18:39,909 --> 00:18:37,590
thank you for that and so ladies this is

401
00:18:42,150 --> 00:18:39,919
really for whoever wants to take it but

402
00:18:45,669 --> 00:18:42,160
jim bloodworth on youtube asks when is

403
00:18:47,669 --> 00:18:45,679
the launch and on what rocket

404
00:18:51,750 --> 00:18:47,679
oh i'll take that one

405
00:18:54,789 --> 00:18:51,760
we're launching october 16 2021 is the

406
00:18:57,110 --> 00:18:54,799
opening of our launch period and we're

407
00:18:58,070 --> 00:18:57,120
launching on an atlas v

408
00:19:03,590 --> 00:18:58,080
uh

409
00:19:08,950 --> 00:19:05,990
nice cannot wait we are under one year

410
00:19:11,110 --> 00:19:08,960
to launch everyone tuning in so uh okay

411
00:19:13,669 --> 00:19:11,120
here's another one

412
00:19:16,230 --> 00:19:13,679
aaron moose sorry if i'm messing that up

413
00:19:19,070 --> 00:19:16,240

on youtube asks can you see the asteroid

414
00:19:20,310 --> 00:19:19,080
with a telescope

415
00:19:23,190 --> 00:19:20,320
[Music]

416
00:19:26,310 --> 00:19:23,200
yes and i'll i'll take that one

417
00:19:29,510 --> 00:19:26,320
you we can see uh the trojan asteroids

418
00:19:31,750 --> 00:19:29,520
with the telescope and in fact uh

419
00:19:34,310 --> 00:19:31,760
recently we discovered a small moon

420
00:19:37,110 --> 00:19:34,320
around one of our trojan targets that

421
00:19:39,669 --> 00:19:37,120
we're going to uh our first target is

422
00:19:41,350 --> 00:19:39,679
called urabades and we recently

423
00:19:43,350 --> 00:19:41,360
discovered an approximately one

424
00:19:44,310 --> 00:19:43,360
kilometer sized moon

425
00:19:45,110 --> 00:19:44,320
uh

426
00:19:47,590 --> 00:19:45,120
from

427
00:19:48,870 --> 00:19:47,600
uh the hubble space telescope

428
00:19:53,029 --> 00:19:48,880
and so this is

429
00:19:54,789 --> 00:19:53,039
uh an example of being able to see uh

430
00:19:57,350 --> 00:19:54,799
that trojan asteroids through a

431
00:20:00,150 --> 00:19:57,360
telescope and also

432
00:20:02,310 --> 00:20:00,160
uh being able to search and learn more

433
00:20:04,870 --> 00:20:02,320
about these interesting targets before

434
00:20:09,190 --> 00:20:04,880
we get there

435
00:20:13,909 --> 00:20:10,870
that the name of the

436
00:20:17,029 --> 00:20:13,919
um the new moon that was just discovered

437
00:20:17,909 --> 00:20:17,039
uh in is named keta

438
00:20:20,630 --> 00:20:17,919

so

439
00:20:21,909 --> 00:20:20,640
it's it's a new discovery that the lucid

440
00:20:25,029 --> 00:20:21,919
team made

441
00:20:27,430 --> 00:20:25,039
with the cable space telescope

442
00:20:28,710 --> 00:20:27,440
so yes on the topic of discoveries oh

443
00:20:31,990 --> 00:20:28,720
sorry

444
00:20:35,750 --> 00:20:32,000
i just wanted to add um about that name

445
00:20:38,230 --> 00:20:35,760
uh the name is in honor of

446
00:20:41,669 --> 00:20:38,240
uh the first woman who was the olympic

447
00:20:44,710 --> 00:20:41,679
torchbearer and so uh we're really happy

448
00:20:49,669 --> 00:20:44,720
to be able to name this small moon in

449
00:20:53,990 --> 00:20:52,149
wow thank you that is a really fun fact

450
00:20:56,710 --> 00:20:54,000
um and so but on the topic of

451
00:20:59,029 --> 00:20:56,720
discoveries alex mann on youtube asks

452
00:21:00,789 --> 00:20:59,039
can lucy theoretically discover new

453
00:21:05,110 --> 00:21:00,799
asteroids on her way through the

454
00:21:09,190 --> 00:21:06,870
i can go ahead and take that

455
00:21:12,149 --> 00:21:09,200
um it is possible that lucy could

456
00:21:13,029 --> 00:21:12,159
discover uh asteroids

457
00:21:16,470 --> 00:21:13,039
uh

458
00:21:17,430 --> 00:21:16,480
either in the trojan asteroid swarms

459
00:21:19,990 --> 00:21:17,440
uh

460
00:21:21,350 --> 00:21:20,000
or potentially in the main belt but it's

461
00:21:23,590 --> 00:21:21,360
unlikely

462
00:21:24,549 --> 00:21:23,600
our telescopes have a very narrow field

463
00:21:27,510 --> 00:21:24,559

of view

464
00:21:30,549 --> 00:21:27,520
our instruments do and so we won't be

465
00:21:33,430 --> 00:21:30,559
trying to search a broad area to find

466
00:21:35,430 --> 00:21:33,440
new main belt or trojan asteroids the

467
00:21:37,990 --> 00:21:35,440
real purpose is to get our first

468
00:21:39,430 --> 00:21:38,000
close-up look at the trojan asteroids

469
00:21:42,630 --> 00:21:39,440
that we'll be

470
00:21:46,870 --> 00:21:45,270
nice so jessica i want to go back to uh

471
00:21:48,549 --> 00:21:46,880
what you mentioned earlier in the show

472
00:21:50,549 --> 00:21:48,559
talking about how many people worked on

473
00:21:52,230 --> 00:21:50,559
this mission and i'm curious to know how

474
00:21:55,190 --> 00:21:52,240
long have these groups been working on

475
00:22:01,510 --> 00:21:58,789
oh wow uh so the discovery proposal for

476
00:22:03,110 --> 00:22:01,520
this i believe was uh started back in

477
00:22:06,789 --> 00:22:03,120
2014

478
00:22:09,270 --> 00:22:06,799
and lucy was awarded in 2016

479
00:22:14,070 --> 00:22:09,280
and so we've been working as a formal

480
00:22:18,630 --> 00:22:16,070
wow and to all come together in this one

481
00:22:21,270 --> 00:22:18,640
big moment next year that is so exciting

482
00:22:23,590 --> 00:22:21,280
um and ladies i've got a really great

483
00:22:27,590 --> 00:22:23,600
question for whoever wants to take it

484
00:22:33,350 --> 00:22:27,600
rehan on um youtube says will any of

485
00:22:38,710 --> 00:22:35,990
well i can start but i probably lose

486
00:22:39,510 --> 00:22:38,720
cathy could follow up

487
00:22:45,590 --> 00:22:39,520
no

488
00:22:49,510 --> 00:22:45,600

are really quite far away there as we

489
00:22:51,750 --> 00:22:49,520
mentioned in the jupiter's orbit so for

490
00:22:54,630 --> 00:22:51,760
them to be uh if they would have to be a

491
00:22:57,510 --> 00:22:54,640
major collision to deviate their their

492
00:22:59,029 --> 00:22:57,520
orbit to bring them closer to the inner

493
00:23:02,390 --> 00:22:59,039
solar system

494
00:23:04,870 --> 00:23:02,400
so there is no potential of impact from

495
00:23:08,470 --> 00:23:04,880
from the trojan asteroids around the

496
00:23:12,710 --> 00:23:11,110
yeah and i can just add that because

497
00:23:15,830 --> 00:23:12,720
they're in these lagrange points which

498
00:23:17,990 --> 00:23:15,840
are stability zones uh these objects are

499
00:23:20,390 --> 00:23:18,000
not going to escape and then impact

500
00:23:23,029 --> 00:23:20,400
earth and what that also means is that

501
00:23:25,669 --> 00:23:23,039
this is probably uh a specific

502
00:23:28,149 --> 00:23:25,679
population that's not represented in our

503
00:23:29,990 --> 00:23:28,159
meteorite collection on the ground

504
00:23:31,190 --> 00:23:30,000
making it even more important to go

505
00:23:31,909 --> 00:23:31,200
visit these

506
00:23:36,630 --> 00:23:31,919
uh

507
00:23:38,549 --> 00:23:36,640
trojan targets with our lucy spacecraft

508
00:23:40,070 --> 00:23:38,559
so kathy earlier you mentioned that if

509
00:23:42,630 --> 00:23:40,080
we were standing on an asteroid we

510
00:23:45,110 --> 00:23:42,640
wouldn't necessarily see the next one um

511
00:23:46,950 --> 00:23:45,120
right around us and gerald on youtube

512
00:23:50,549 --> 00:23:46,960
asks how long do you think it will take

513
00:23:51,430 --> 00:23:50,559

to go from asteroid to asteroid

514
00:23:53,190 --> 00:23:51,440
oh

515
00:23:55,350 --> 00:23:53,200
that's pretty interesting

516
00:23:58,630 --> 00:23:55,360
we have this really

517
00:23:59,669 --> 00:23:58,640
amazing trajectory that enables our

518
00:24:01,990 --> 00:23:59,679
uh

519
00:24:04,149 --> 00:24:02,000
our voyage through the trojan asteroids

520
00:24:07,430 --> 00:24:04,159
and you can see it here in this

521
00:24:09,590 --> 00:24:07,440
animation this is in a frame rotating

522
00:24:12,549 --> 00:24:09,600
with jupiter and so

523
00:24:15,269 --> 00:24:12,559
uh the blue line is uh the lucy

524
00:24:16,310 --> 00:24:15,279
trajectory and we fly

525
00:24:19,510 --> 00:24:16,320
out

526
00:24:21,590 --> 00:24:19,520
uh do two gravity assists past earth to

527
00:24:23,990 --> 00:24:21,600
pump up our aphelion so that we can get

528
00:24:27,750 --> 00:24:24,000
to the trojan asteroids then we fly

529
00:24:29,750 --> 00:24:27,760
through the l4 swarm visiting uh five

530
00:24:32,390 --> 00:24:29,760
different trojan asteroids

531
00:24:35,190 --> 00:24:32,400
first we visit like i said uh eurobabies

532
00:24:39,110 --> 00:24:35,200
and it's moon ketta and just 30 days

533
00:24:41,190 --> 00:24:39,120
later we fly past palomili but it's not

534
00:24:43,350 --> 00:24:41,200
until years later that we fly past

535
00:24:45,750 --> 00:24:43,360
patroclus and menonicious

536
00:24:46,710 --> 00:24:45,760
later in the l5 swarm

537
00:24:49,430 --> 00:24:46,720
so

538
00:24:54,870 --> 00:24:49,440

uh look forward to encounters with

539
00:25:02,070 --> 00:24:59,390
wow nice for a long time and jessica uh

540
00:25:05,430 --> 00:25:02,080
doggygamer13 on youtube asks how fast

541
00:25:10,870 --> 00:25:07,430
well when we're flying by the trojan

542
00:25:12,710 --> 00:25:10,880
asteroids we fly by between six and nine

543
00:25:15,029 --> 00:25:12,720
kilometers a second

544
00:25:19,269 --> 00:25:15,039
so that's kind of like doing a 10k in

545
00:25:22,630 --> 00:25:21,029
and one thing i'd like you to add to

546
00:25:24,950 --> 00:25:22,640
that is

547
00:25:26,549 --> 00:25:24,960
imagine as we're flying by trying to

548
00:25:29,590 --> 00:25:26,559
take images

549
00:25:31,990 --> 00:25:29,600
at those great speeds and part of the

550
00:25:33,190 --> 00:25:32,000
uh really interesting engineering on

551
00:25:35,269 --> 00:25:33,200
this mission

552
00:25:36,870 --> 00:25:35,279
is those are those terminal tracking

553
00:25:38,630 --> 00:25:36,880
cameras that i mentioned and they're

554
00:25:39,750 --> 00:25:38,640
mounted on an instrument pointing

555
00:25:44,789 --> 00:25:39,760
platform

556
00:25:47,750 --> 00:25:44,799
so that we can remain targeted on the

557
00:25:50,630 --> 00:25:47,760
trojan asteroid as we fly past at such

558
00:25:53,909 --> 00:25:51,990
so kathy

559
00:25:55,830 --> 00:25:53,919
do you know how

560
00:25:58,390 --> 00:25:55,840
how good of resolution are we talking

561
00:26:00,310 --> 00:25:58,400
about with these images

562
00:26:02,549 --> 00:26:00,320
oh the resolution is going to totally

563
00:26:05,029 --> 00:26:02,559

transform our understanding of these

564
00:26:07,029 --> 00:26:05,039
trojan asteroids

565
00:26:10,630 --> 00:26:07,039
our highest resolution images will be

566
00:26:12,310 --> 00:26:10,640
about 14 meters per pixel so

567
00:26:13,909 --> 00:26:12,320
you will be able to see geologic

568
00:26:15,590 --> 00:26:13,919
features on their surface will be able

569
00:26:19,990 --> 00:26:15,600
to count craters

570
00:26:25,029 --> 00:26:23,190
nice and so this is for everyone astro

571
00:26:27,190 --> 00:26:25,039
girl on twitter wants to know why are

572
00:26:31,430 --> 00:26:27,200
there so many asteroids between mars and

573
00:26:37,350 --> 00:26:34,470
well um i can start it and then

574
00:26:38,470 --> 00:26:37,360
i'm sure cathy or jessica can follow up

575
00:26:40,710 --> 00:26:38,480
you know

576
00:26:43,590 --> 00:26:40,720
it's important to note that the trojan

577
00:26:46,310 --> 00:26:43,600
asteroids is a different family from

578
00:26:49,750 --> 00:26:46,320
the ones from the main belt dust

579
00:26:53,990 --> 00:26:49,760
the main belt which reside between

580
00:26:56,390 --> 00:26:54,000
mars and jupiter so and again we have

581
00:26:59,029 --> 00:26:56,400
visited the main belt asteroids with

582
00:27:02,870 --> 00:26:59,039
many other missions and we are planning

583
00:27:06,630 --> 00:27:02,880
to continue that relation is a set of

584
00:27:09,029 --> 00:27:06,640
a family of objects that are extremely

585
00:27:11,350 --> 00:27:09,039
importantly understand the chronology

586
00:27:13,990 --> 00:27:11,360
and the formation of the planet within

587
00:27:16,870 --> 00:27:14,000
the solar system but the trojan family

588
00:27:21,190 --> 00:27:16,880

that as i mentioned is we have mentioned

589
00:27:23,430 --> 00:27:21,200
that it has never been a study and

590
00:27:25,110 --> 00:27:23,440
they are the remnants you know during

591
00:27:27,029 --> 00:27:25,120
the formation of the system there were

592
00:27:27,830 --> 00:27:27,039
great collisions

593
00:27:36,630 --> 00:27:27,840
and

594
00:27:38,630 --> 00:27:36,640
material that did not accrete

595
00:27:39,909 --> 00:27:38,640
sufficiently

596
00:27:42,870 --> 00:27:39,919
to form

597
00:27:45,990 --> 00:27:42,880
all planets so

598
00:27:49,350 --> 00:27:46,000
these dogs that were left over from the

599
00:27:50,149 --> 00:27:49,360
planetary formation uh during

600
00:27:52,549 --> 00:27:50,159
of

601
00:27:54,630 --> 00:27:52,559
you know during the early solar system

602
00:27:57,669 --> 00:27:54,640
and that's why we have so many asteroids

603
00:27:59,750 --> 00:27:57,679
or these objects in the main belt in the

604
00:28:02,310 --> 00:27:59,760
trojans and as well

605
00:28:04,070 --> 00:28:02,320
far far away in the kuiper belt so

606
00:28:05,830 --> 00:28:04,080
they're they're all different families

607
00:28:07,269 --> 00:28:05,840
and they relate and we're trying to

608
00:28:10,149 --> 00:28:07,279
understand them

609
00:28:12,389 --> 00:28:10,159
what the relationship is

610
00:28:13,990 --> 00:28:12,399
thank you so much unfortunately that's

611
00:28:15,430 --> 00:28:14,000
all the time we have for today i feel

612
00:28:18,630 --> 00:28:15,440
like we could talk about this mission

613
00:28:20,710 --> 00:28:18,640

all day adriana kathy and jessica thank

614
00:28:22,870 --> 00:28:20,720
you so much for joining us and for those

615
00:28:24,950 --> 00:28:22,880
tuning in thank you for watching and

616
00:28:27,669 --> 00:28:24,960
thank you for those great questions we

617
00:28:31,190 --> 00:28:27,679
are less than one year away from lucy's

618
00:28:34,310 --> 00:28:31,200
october 2021 launch date and be sure to

619
00:28:36,630 --> 00:28:34,320
visit nasa.gov lucy to for more

620
00:28:38,389 --> 00:28:36,640
information about the mission and if you

621
00:28:40,630 --> 00:28:38,399
want to stay up to date on mission

622
00:28:43,269 --> 00:28:40,640
milestones and activities be sure to

623
00:28:45,990 --> 00:28:43,279
follow nasa's solar system on facebook

624
00:28:52,770 --> 00:28:46,000
twitter and instagram again thank you so