1
00:00:04,550 --> 00:00:02,389
hi we're live at goddard space flight

2
00:00:06,710 --> 00:00:04,560
center i'm erin kisslick and we are here

3
00:00:08,390 --> 00:00:06,720
today talking about exo moons there's

4
00:00:10,470 --> 00:00:08,400
been a lot of excitement this week

5
00:00:12,310 --> 00:00:10,480
between nasa's 60th anniversary and this

6
00:00:13,830 --> 00:00:12,320
new potential exo moon so i've got the

7
00:00:16,470 --> 00:00:13,840
experts here to talk to you a little bit

8
00:00:19,429 --> 00:00:16,480
about it i've got dr jennifer wiseman

9
00:00:21,590 --> 00:00:19,439
and i've got dr nicole colon and um send

10
00:00:23,509 --> 00:00:21,600
in your questions to hashtag ask nasa

11
00:00:24,470 --> 00:00:23,519
and we'll get to just as many as we can

12
00:00:27,189 --> 00:00:24,480
so

13
00:00:28,710 --> 00:00:27,199

let's jump right in jennifer what is an

14
00:00:35,110 --> 00:00:28,720
exo moon

15
00:00:37,830 --> 00:00:35,120
that's outside our solar system the exo

16
00:00:40,869 --> 00:00:37,840
part is the outside part and as you know

17
00:00:43,510 --> 00:00:40,879
we've been just detecting thousands of

18
00:00:44,470 --> 00:00:43,520
planets outside our solar system over

19
00:00:45,830 --> 00:00:44,480
the last

20
00:00:47,910 --> 00:00:45,840
couple of decades or so it's very

21
00:00:50,150 --> 00:00:47,920
exciting but we've always wondered if

22
00:00:52,310 --> 00:00:50,160
any of those planets that are orbiting

23
00:00:54,389 --> 00:00:52,320
stars other than our sun

24
00:00:56,790 --> 00:00:54,399
could also have moons like many of the

25
00:00:58,790 --> 00:00:56,800
planets in our own solar system have and

26
00:01:01,349 --> 00:00:58,800
now we have some intriguing evidence

27
00:01:03,430 --> 00:01:01,359
that we may have found one such system

28
00:01:04,950 --> 00:01:03,440
that's really exciting so a new moon in

29
00:01:07,190 --> 00:01:04,960
a new place um

30
00:01:09,030 --> 00:01:07,200
nicole how do we go about finding

31
00:01:10,950 --> 00:01:09,040
something that we've never found before

32
00:01:12,469 --> 00:01:10,960
how do you find an exo moon that's a

33
00:01:14,149 --> 00:01:12,479
really great question

34
00:01:17,109 --> 00:01:14,159
there are several ways to find

35
00:01:19,109 --> 00:01:17,119
exoplanets and one of the ways that we

36
00:01:21,429 --> 00:01:19,119
would prefer to find them is to take a

37
00:01:23,109 --> 00:01:21,439
direct picture of it so we can see it

38
00:01:25,510 --> 00:01:23,119

you know it's in all its glory but

39
00:01:26,630 --> 00:01:25,520
that's really difficult to do

40
00:01:29,590 --> 00:01:26,640
because

41
00:01:31,670 --> 00:01:29,600
the stars are so bright and direct

42
00:01:33,429 --> 00:01:31,680
imaging often you need to block the

43
00:01:35,190 --> 00:01:33,439
light from the star and the planet

44
00:01:37,270 --> 00:01:35,200
itself is so faint and so small in

45
00:01:40,230 --> 00:01:37,280
comparison that we have to use what we

46
00:01:43,190 --> 00:01:40,240
call indirect methods to instead detect

47
00:01:45,910 --> 00:01:43,200
these exoplanets so in this case of this

48
00:01:47,350 --> 00:01:45,920
exoplanet and exomoon system

49
00:01:48,310 --> 00:01:47,360
we use something called the transit

50
00:01:49,429 --> 00:01:48,320
method

51
00:01:52,230 --> 00:01:49,439
and so

52
00:01:54,149 --> 00:01:52,240
what this is is we

53
00:01:56,310 --> 00:01:54,159
look at a star and we measure its

54
00:01:58,950 --> 00:01:56,320
brightness over time

55
00:02:01,270 --> 00:01:58,960
and essentially we're looking to see

56
00:02:04,069 --> 00:02:01,280
regular dips of brightness

57
00:02:06,550 --> 00:02:04,079
in the stars light so as illustrated

58
00:02:08,790 --> 00:02:06,560
here when you have some type of size

59
00:02:10,630 --> 00:02:08,800
planet like a jupiter-sized planet which

60
00:02:13,030 --> 00:02:10,640
is the case here

61
00:02:15,350 --> 00:02:13,040
the jupiter comes in and it blocks some

62
00:02:17,589 --> 00:02:15,360
fraction of light from the star causing

63
00:02:20,869 --> 00:02:17,599

a big dip in the light

64
00:02:24,229 --> 00:02:20,879
but then in this case we also saw an

65
00:02:27,110 --> 00:02:24,239
exomoon signal which happened because we

66
00:02:29,270 --> 00:02:27,120
saw a tinier dip of light that came

67
00:02:30,630 --> 00:02:29,280
around the same time

68
00:02:33,030 --> 00:02:30,640
as the

69
00:02:34,949 --> 00:02:33,040
transit of the jupiter-sized planet so

70
00:02:37,830 --> 00:02:34,959
here there's another

71
00:02:41,110 --> 00:02:37,840
smaller object that causes a teeny tiny

72
00:02:44,070 --> 00:02:41,120
little dip over here and so this is what

73
00:02:46,550 --> 00:02:44,080
we saw when we discovered this candidate

74
00:02:50,390 --> 00:02:46,560
exomoon system

75
00:02:52,390 --> 00:02:50,400
but backing stepping taking a step back

76
00:02:53,589 --> 00:02:52,400
what telescopes did we actually use to

77
00:02:55,750 --> 00:02:53,599
do this

78
00:02:58,790 --> 00:02:55,760
those were the kepler space telescope

79
00:03:00,710 --> 00:02:58,800
and the hubble space telescope so kepler

80
00:03:03,110 --> 00:03:00,720
ran the original survey

81
00:03:04,710 --> 00:03:03,120
using the same transit method to find

82
00:03:05,670 --> 00:03:04,720
thousands of planets as jennifer

83
00:03:08,149 --> 00:03:05,680
mentioned

84
00:03:09,910 --> 00:03:08,159
and kepler stared at one part of the sky

85
00:03:13,270 --> 00:03:09,920
to do this

86
00:03:14,229 --> 00:03:13,280
but in all those planets that kepler

87
00:03:16,869 --> 00:03:14,239
found

88
00:03:18,710 --> 00:03:16,879

only one viable eczeman candidate was

89
00:03:20,630 --> 00:03:18,720
discovered and so that's why it was so

90
00:03:22,149 --> 00:03:20,640
exciting to astronomers

91
00:03:23,110 --> 00:03:22,159
and after that

92
00:03:24,949 --> 00:03:23,120
we

93
00:03:27,350 --> 00:03:24,959
astronomers decided to use the hubble

94
00:03:30,229 --> 00:03:27,360
space telescope to follow it up and

95
00:03:33,350 --> 00:03:30,239
verify the signal that we originally saw

96
00:03:35,430 --> 00:03:33,360
in the kepler data so hubble was able to

97
00:03:37,830 --> 00:03:35,440
provide a more precise measurement it

98
00:03:39,589 --> 00:03:37,840
has more sensitive instruments basically

99
00:03:42,390 --> 00:03:39,599
and so we were able to recover this

100
00:03:43,589 --> 00:03:42,400
signal and verify that we do indeed have

101
00:03:47,509 --> 00:03:43,599
a

102
00:03:49,670 --> 00:03:47,519
system now

103
00:03:51,350 --> 00:03:49,680
that's so exciting so many different

104
00:03:53,030 --> 00:03:51,360
telescopes working together i just want

105
00:03:54,869 --> 00:03:53,040
to remind everybody just joining us now

106
00:03:56,630 --> 00:03:54,879
that we're at nasa's goddard space

107
00:03:58,710 --> 00:03:56,640
flight center and we are talking about

108
00:04:00,390 --> 00:03:58,720
exo moons and if you have questions send

109
00:04:02,149 --> 00:04:00,400
them into hashtag ask nasa and we're

110
00:04:04,869 --> 00:04:02,159
getting to just as many as we can today

111
00:04:06,550 --> 00:04:04,879
during the show so jennifer we have our

112
00:04:09,509 --> 00:04:06,560
own moon and we know about other moons

113
00:04:11,750 --> 00:04:09,519

in our solar system is this moon like

114
00:04:13,830 --> 00:04:11,760
the moons we already know

115
00:04:16,710 --> 00:04:13,840
well erin we don't know too much about

116
00:04:17,909 --> 00:04:16,720
this system yet but we know a little bit

117
00:04:18,949 --> 00:04:17,919
we know

118
00:04:22,469 --> 00:04:18,959
that

119
00:04:24,310 --> 00:04:22,479
the size of the moon is much bigger than

120
00:04:25,749 --> 00:04:24,320
the moons that we are accustomed to in

121
00:04:27,830 --> 00:04:25,759
our own solar system i mean we have a

122
00:04:31,030 --> 00:04:27,840
huge variety of moons

123
00:04:33,110 --> 00:04:31,040
in our solar system over 170 moons

124
00:04:35,110 --> 00:04:33,120
but they come in many different sizes

125
00:04:38,150 --> 00:04:35,120
and in many different

126
00:04:41,030 --> 00:04:38,160
types of environments

127
00:04:43,909 --> 00:04:41,040
everything from the hot

128
00:04:46,950 --> 00:04:43,919
volcanic moon of io to these ice covered

129
00:04:48,629 --> 00:04:46,960
moons and even moons that are you know

130
00:04:51,270 --> 00:04:48,639
comparable to

131
00:04:52,790 --> 00:04:51,280
our moon or big herb but we don't have

132
00:04:55,590 --> 00:04:52,800
the type of moon that we're seeing in

133
00:04:57,510 --> 00:04:55,600
this system this system seems to have a

134
00:04:59,430 --> 00:04:57,520
moon that's really about the size of

135
00:05:01,350 --> 00:04:59,440
neptune it's huge

136
00:05:03,670 --> 00:05:01,360
and it's orbiting a

137
00:05:05,430 --> 00:05:03,680
planet that would be like jupiter

138
00:05:07,990 --> 00:05:05,440

basically in size

139
00:05:10,469 --> 00:05:08,000
this moon would probably be more like a

140
00:05:13,670 --> 00:05:10,479
gaseous body so we don't really have a

141
00:05:16,150 --> 00:05:13,680
gaseous type moon that we know of in our

142
00:05:17,990 --> 00:05:16,160
own solar system so in that sense it

143
00:05:19,909 --> 00:05:18,000
would be very different from the types

144
00:05:22,790 --> 00:05:19,919
of moons we're accustomed to studying in

145
00:05:24,230 --> 00:05:22,800
our own solar system however in one way

146
00:05:25,510 --> 00:05:24,240
it's not uh

147
00:05:27,029 --> 00:05:25,520
all that different from what we're

148
00:05:29,990 --> 00:05:27,039
accustomed to and that's in the sense

149
00:05:31,830 --> 00:05:30,000
that this planet and potential moon

150
00:05:34,070 --> 00:05:31,840
is orbiting a star that's not too

151
00:05:36,230 --> 00:05:34,080
different from our sun and orbiting it

152
00:05:39,749 --> 00:05:36,240
about the same distance from that star

153
00:05:42,310 --> 00:05:39,759
that our earth is orbiting from our sun

154
00:05:44,230 --> 00:05:42,320
and so it has a similar length of year

155
00:05:45,830 --> 00:05:44,240
the planet does and

156
00:05:47,909 --> 00:05:45,840
probably

157
00:05:49,749 --> 00:05:47,919
a similar type of environment in the

158
00:05:51,590 --> 00:05:49,759
sense that it is in what we call the

159
00:05:53,749 --> 00:05:51,600
habitable zone

160
00:05:55,590 --> 00:05:53,759
around that star that doesn't

161
00:05:57,830 --> 00:05:55,600
necessarily mean there's life there but

162
00:05:59,990 --> 00:05:57,840
it means that the temperatures there

163
00:06:02,550 --> 00:06:00,000

would be moderate enough that you could

164
00:06:03,590 --> 00:06:02,560
potentially have liquid water

165
00:06:05,749 --> 00:06:03,600
in that

166
00:06:07,670 --> 00:06:05,759
region however given that it's probably

167
00:06:10,230 --> 00:06:07,680
a big gaseous thing

168
00:06:11,590 --> 00:06:10,240
it's not going to be like oceans and

169
00:06:13,110 --> 00:06:11,600
lakes so

170
00:06:14,629 --> 00:06:13,120
mostly it's different from what we're

171
00:06:16,629 --> 00:06:14,639
accustomed to here

172
00:06:18,469 --> 00:06:16,639
thank you so we got a new moon and a new

173
00:06:20,469 --> 00:06:18,479
place we're learning all kinds of new

174
00:06:23,189 --> 00:06:20,479
things and like you said nicole

175
00:06:25,510 --> 00:06:23,199
it took two telescopes to figure this

176
00:06:27,110 --> 00:06:25,520
out so what's the plan going forward do

177
00:06:28,629 --> 00:06:27,120
we have any more ways to gather even

178
00:06:30,230 --> 00:06:28,639
more evidence from maybe other

179
00:06:32,950 --> 00:06:30,240
telescopes

180
00:06:34,710 --> 00:06:32,960
well first we hope that hubble itself

181
00:06:36,309 --> 00:06:34,720
we'll be able to look at this planet

182
00:06:37,510 --> 00:06:36,319
again um

183
00:06:38,390 --> 00:06:37,520
the

184
00:06:40,629 --> 00:06:38,400
issue

185
00:06:42,790 --> 00:06:40,639
with this is that because jennifer just

186
00:06:45,029 --> 00:06:42,800
mentioned it has such a large orbit

187
00:06:47,189 --> 00:06:45,039
almost as long as our own year

188
00:06:50,230 --> 00:06:47,199

it takes a long time before it transits

189
00:06:53,110 --> 00:06:50,240
again so it only transits every so often

190
00:06:55,350 --> 00:06:53,120
so we can only look to at the signal

191
00:06:57,270 --> 00:06:55,360
every so often and so

192
00:06:59,830 --> 00:06:57,280
hubble might have a chance to look at

193
00:07:02,710 --> 00:06:59,840
this again next may actually

194
00:07:05,270 --> 00:07:02,720
and beyond that the james webb space

195
00:07:08,150 --> 00:07:05,280
telescope is expected to launch in a few

196
00:07:10,150 --> 00:07:08,160
years and that has also

197
00:07:11,270 --> 00:07:10,160
very sensitive instruments

198
00:07:14,070 --> 00:07:11,280
and

199
00:07:17,110 --> 00:07:14,080
a a large mirror that can collect a lot

200
00:07:19,189 --> 00:07:17,120
of light to get very precise data so we

201
00:07:20,150 --> 00:07:19,199
can again look to recover the same

202
00:07:22,710 --> 00:07:20,160
signal

203
00:07:25,110 --> 00:07:22,720
and you know help verify this

204
00:07:28,390 --> 00:07:25,120
this exomoon candidate that has been

205
00:07:31,110 --> 00:07:28,400
identified and in addition

206
00:07:31,830 --> 00:07:31,120
beyond just looking at the same system

207
00:07:34,469 --> 00:07:31,840
the

208
00:07:37,749 --> 00:07:34,479
tess mission just started collecting

209
00:07:39,990 --> 00:07:37,759
data recently and it launched in april

210
00:07:42,390 --> 00:07:40,000
of this year and tess is the transiting

211
00:07:43,510 --> 00:07:42,400
exoplanet survey satellite

212
00:07:45,350 --> 00:07:43,520
and

213
00:07:48,950 --> 00:07:45,360

since uh july actually it started

214
00:07:51,430 --> 00:07:48,960
science it is basically doing a nearly

215
00:07:53,110 --> 00:07:51,440
all sky survey compared to the kepler

216
00:07:54,150 --> 00:07:53,120
mission which observed just one part of

217
00:07:56,790 --> 00:07:54,160
the sky

218
00:07:59,110 --> 00:07:56,800
tess is looking at almost the entire sky

219
00:08:01,430 --> 00:07:59,120
for exoplanets doing the same exact

220
00:08:03,670 --> 00:08:01,440
thing looking for dips in the light

221
00:08:05,749 --> 00:08:03,680
and in this case

222
00:08:08,309 --> 00:08:05,759
tess is looking at a lot of bright stars

223
00:08:10,070 --> 00:08:08,319
a lot of nearby stars so it's looking at

224
00:08:12,150 --> 00:08:10,080
a very different sample of stars and

225
00:08:14,230 --> 00:08:12,160
kepler looked at but there's still a

226
00:08:16,230 --> 00:08:14,240
possibility that we will find lots of

227
00:08:19,029 --> 00:08:16,240
planets and maybe some of those will

228
00:08:20,390 --> 00:08:19,039
have exo moons around them so i guess

229
00:08:21,990 --> 00:08:20,400
we'll all have to stay tuned and

230
00:08:23,029 --> 00:08:22,000
speaking of stay tuned maybe you're just

231
00:08:24,469 --> 00:08:23,039
tuning in

232
00:08:26,150 --> 00:08:24,479
we're live at nasa's goddard space

233
00:08:29,110 --> 00:08:26,160
flight center we're talking about exo

234
00:08:31,270 --> 00:08:29,120
moons crazy um send your questions in to

235
00:08:33,430 --> 00:08:31,280
hashtag ask nasa and we'll get to just

236
00:08:34,790 --> 00:08:33,440
as many as we can throughout the show um

237
00:08:36,230 --> 00:08:34,800
one of the questions that i had seen

238
00:08:38,310 --> 00:08:36,240

from the press release when it came out

239
00:08:41,670 --> 00:08:38,320
on wednesday people were asking about

240
00:08:44,070 --> 00:08:41,680
how you know how far is this away from

241
00:08:47,670 --> 00:08:44,080
us oh good question so

242
00:08:50,230 --> 00:08:47,680
um we think this system is about 8 000

243
00:08:52,389 --> 00:08:50,240
light years away of course the light

244
00:08:55,190 --> 00:08:52,399
year is the distance that it takes for

245
00:08:57,030 --> 00:08:55,200
light to travel in a year and so it's

246
00:08:59,829 --> 00:08:57,040
not right around the corner from our

247
00:09:02,470 --> 00:08:59,839
solar system but it is in our galaxy and

248
00:09:04,630 --> 00:09:02,480
not too far away cosmically speaking so

249
00:09:07,829 --> 00:09:04,640
it's in the the um

250
00:09:10,630 --> 00:09:07,839
uh constellation sagittarius or no

251
00:09:12,230 --> 00:09:10,640
what's the oh it's in cygnus cygnus

252
00:09:14,150 --> 00:09:12,240
sorry it's in cygnus this is the region

253
00:09:16,230 --> 00:09:14,160
of the sky that kepler was

254
00:09:17,990 --> 00:09:16,240
observing and so that's why the system

255
00:09:19,430 --> 00:09:18,000
was found in the first place by kepler

256
00:09:21,590 --> 00:09:19,440
and so um

257
00:09:22,470 --> 00:09:21,600
it's not easy for us to see

258
00:09:24,710 --> 00:09:22,480
especially

259
00:09:26,550 --> 00:09:24,720
this candidate of an exo moon we have to

260
00:09:29,430 --> 00:09:26,560
have powerful telescopes but it's in our

261
00:09:31,670 --> 00:09:29,440
own galaxy so it's not terribly far away

262
00:09:34,230 --> 00:09:31,680
no astronomically

263
00:09:36,870 --> 00:09:34,240

so it's not so far away another question

264
00:09:39,430 --> 00:09:36,880
we're getting of course is um could

265
00:09:41,350 --> 00:09:39,440
there be life

266
00:09:43,430 --> 00:09:41,360
could there be yeah that's a question

267
00:09:44,230 --> 00:09:43,440
everybody always wants to know

268
00:09:46,630 --> 00:09:44,240
and

269
00:09:50,470 --> 00:09:46,640
again this this system this planet in

270
00:09:53,110 --> 00:09:50,480
this moon exomoon is orbiting at a

271
00:09:55,350 --> 00:09:53,120
distance from its star that means that

272
00:09:57,430 --> 00:09:55,360
at that region the temperature it has

273
00:09:59,590 --> 00:09:57,440
could be a temperature where liquid

274
00:10:01,829 --> 00:09:59,600
water exists or it is a temperature

275
00:10:04,710 --> 00:10:01,839
where liquid water exists but these two

276
00:10:08,069 --> 00:10:04,720
particular objects are so um large and

277
00:10:09,829 --> 00:10:08,079
massive that they're basically um like

278
00:10:11,750 --> 00:10:09,839
balls of gas you know they're not

279
00:10:12,470 --> 00:10:11,760
they're they're gas giants essentially

280
00:10:14,870 --> 00:10:12,480
or

281
00:10:16,069 --> 00:10:14,880
and they're nothing um like our own

282
00:10:17,910 --> 00:10:16,079
earth you know they don't have this

283
00:10:21,110 --> 00:10:17,920
rocky surface that you can really walk

284
00:10:24,310 --> 00:10:21,120
around on so the prospects of life on

285
00:10:25,269 --> 00:10:24,320
this planet and this moon itself

286
00:10:26,310 --> 00:10:25,279
is

287
00:10:27,269 --> 00:10:26,320
very slim

288
00:10:29,190 --> 00:10:27,279

but

289
00:10:31,670 --> 00:10:29,200
where there's one planet often we find

290
00:10:33,030 --> 00:10:31,680
more so there might be more planets in

291
00:10:33,910 --> 00:10:33,040
the system

292
00:10:35,829 --> 00:10:33,920
where

293
00:10:38,310 --> 00:10:35,839
you know could be that could be rocky we

294
00:10:40,870 --> 00:10:38,320
just haven't had the um

295
00:10:42,389 --> 00:10:40,880
the sensitivity to detect them yet so

296
00:10:44,949 --> 00:10:42,399
that's something that you know we'll see

297
00:10:45,990 --> 00:10:44,959
in the future if we're able to tell

298
00:10:48,470 --> 00:10:46,000
whether or not there's additional

299
00:10:50,710 --> 00:10:48,480
planets in the system that could have

300
00:10:52,630 --> 00:10:50,720
ingredients for life well i guess we'll

301
00:10:53,829 --> 00:10:52,640
have to stay tuned um and we're actually

302
00:10:55,110 --> 00:10:53,839
starting to take in some of your

303
00:10:57,509 --> 00:10:55,120
questions keep sending them and i've got

304
00:11:00,710 --> 00:10:57,519
some really good ones here um

305
00:11:03,030 --> 00:11:00,720
hashtag ask nasa of course um so

306
00:11:05,269 --> 00:11:03,040
jennifer we're just talking about the

307
00:11:06,310 --> 00:11:05,279
temperature of the moon what what is the

308
00:11:07,910 --> 00:11:06,320
temperature

309
00:11:09,829 --> 00:11:07,920
of the moon

310
00:11:13,269 --> 00:11:09,839
well again we don't know too much about

311
00:11:15,269 --> 00:11:13,279
this moon yet we know roughly its size

312
00:11:17,190 --> 00:11:15,279
it's mass it's huge

313
00:11:19,030 --> 00:11:17,200

but we don't really know all these

314
00:11:20,870 --> 00:11:19,040
details but we can kind of estimate the

315
00:11:23,430 --> 00:11:20,880
researchers who who

316
00:11:25,030 --> 00:11:23,440
were detecting this object estimated as

317
00:11:27,190 --> 00:11:25,040
temperature based on its distance and

318
00:11:30,710 --> 00:11:27,200
likely composition so we think it's a

319
00:11:33,990 --> 00:11:30,720
balmy maybe 80 degrees fahrenheit up to

320
00:11:37,030 --> 00:11:34,000
170 degrees fahrenheit so you know warm

321
00:11:41,190 --> 00:11:37,040
but not boiling hot yes

322
00:11:45,990 --> 00:11:43,430
so nicole was this was this a surprise

323
00:11:47,750 --> 00:11:46,000
for scientists when we saw this thing

324
00:11:49,990 --> 00:11:47,760
was it was it shocking or were we

325
00:11:52,310 --> 00:11:50,000
looking for it what

326
00:11:55,190 --> 00:11:52,320
well you know thinking about our own

327
00:11:57,350 --> 00:11:55,200
solar system where we have a lot of

328
00:11:58,790 --> 00:11:57,360
planets and we have a lot of moons

329
00:12:01,190 --> 00:11:58,800
around those planets

330
00:12:05,430 --> 00:12:01,200
jupiter and saturn both have many many

331
00:12:07,269 --> 00:12:05,440
planets or sorry many moons around them

332
00:12:08,870 --> 00:12:07,279
you know there's so many moons in our

333
00:12:11,350 --> 00:12:08,880
own solar system essentially that

334
00:12:13,509 --> 00:12:11,360
finding even just one outside

335
00:12:15,269 --> 00:12:13,519
our solar system around another star

336
00:12:17,190 --> 00:12:15,279
around another planet is not that

337
00:12:19,269 --> 00:12:17,200
surprising

338
00:12:22,230 --> 00:12:19,279

it's just it shows you though since

339
00:12:25,910 --> 00:12:22,240
we've only found one how difficult it is

340
00:12:27,990 --> 00:12:25,920
to find these small signals and so

341
00:12:28,949 --> 00:12:28,000
you know i'm sure over time we can find

342
00:12:29,829 --> 00:12:28,959
more

343
00:12:31,269 --> 00:12:29,839
but

344
00:12:34,230 --> 00:12:31,279
who knows if there'll be anything like

345
00:12:36,629 --> 00:12:34,240
our own moon earth system you never know

346
00:12:37,509 --> 00:12:36,639
all right so a few more questions coming

347
00:12:39,509 --> 00:12:37,519
in

348
00:12:41,910 --> 00:12:39,519
um

349
00:12:44,550 --> 00:12:41,920
jennifer is it possible to one day find

350
00:12:48,470 --> 00:12:44,560
exoplanets that have binary orbits like

351
00:12:49,910 --> 00:12:48,480
pluto or and sharon in that system

352
00:12:51,509 --> 00:12:49,920
well um

353
00:12:53,350 --> 00:12:51,519
certainly it's possible i mean this is

354
00:12:55,750 --> 00:12:53,360
very interesting

355
00:12:57,990 --> 00:12:55,760
if you have you know one body orbiting a

356
00:13:00,069 --> 00:12:58,000
star and then something perhaps orbiting

357
00:13:01,829 --> 00:13:00,079
that body as we do in a moon planet

358
00:13:04,790 --> 00:13:01,839
system but then there can also be sort

359
00:13:06,949 --> 00:13:04,800
of binary planet situations

360
00:13:09,430 --> 00:13:06,959
the definition of that is not always

361
00:13:11,190 --> 00:13:09,440
completely clear so it's certainly

362
00:13:13,910 --> 00:13:11,200
possible in this system that we might

363
00:13:16,230 --> 00:13:13,920

have a binary planetary system

364
00:13:18,710 --> 00:13:16,240
in this case though the candidate moon

365
00:13:20,829 --> 00:13:18,720
that we have is something like

366
00:13:23,990 --> 00:13:20,839
um you know

367
00:13:27,990 --> 00:13:24,000
1.5 percent the mass of its

368
00:13:31,350 --> 00:13:28,000
planet that's similar to the earth

369
00:13:34,389 --> 00:13:31,360
and our moon ratio of mass the size

370
00:13:37,750 --> 00:13:34,399
difference is pronounced between also

371
00:13:39,269 --> 00:13:37,760
between this moon and its planet and so

372
00:13:40,710 --> 00:13:39,279
it's more

373
00:13:43,829 --> 00:13:40,720
i think it would be more accurately

374
00:13:46,230 --> 00:13:43,839
described if this is confirmed as a moon

375
00:13:49,110 --> 00:13:46,240
planet system as opposed to a binary

376
00:13:51,990 --> 00:13:49,120
planet system simply because of that

377
00:13:54,230 --> 00:13:52,000
difference in size and mass ratio but we

378
00:13:55,990 --> 00:13:54,240
need a few more observations to to learn

379
00:13:57,030 --> 00:13:56,000
more details and it's interesting you

380
00:13:59,110 --> 00:13:57,040
should say that because the very next

381
00:14:00,710 --> 00:13:59,120
question that i got in was how big is

382
00:14:04,710 --> 00:14:00,720
the moon

383
00:14:06,790 --> 00:14:04,720
well it's it's large i mean we think um

384
00:14:09,910 --> 00:14:06,800
again we can compare it to something

385
00:14:11,430 --> 00:14:09,920
like neptune in our own solar system so

386
00:14:14,790 --> 00:14:11,440
uh you know we're not used to having

387
00:14:17,030 --> 00:14:14,800
moons that are bigger than planet that

388
00:14:19,110 --> 00:14:17,040

much bigger than planet earth in our own

389
00:14:21,350 --> 00:14:19,120
solar system so it's really hard to

390
00:14:23,750 --> 00:14:21,360
compare this is you know think about the

391
00:14:25,110 --> 00:14:23,760
earth moon system that we're accustomed

392
00:14:26,949 --> 00:14:25,120
to and then

393
00:14:29,829 --> 00:14:26,959
expand it

394
00:14:32,509 --> 00:14:29,839
and then you've got this a huge system a

395
00:14:35,350 --> 00:14:32,519
very large jupiter-like planet with a

396
00:14:36,389 --> 00:14:35,360
neptune-sized moon both gaseous type

397
00:14:39,590 --> 00:14:36,399
bodies

398
00:14:41,269 --> 00:14:39,600
um as the system so it's much larger

399
00:14:43,750 --> 00:14:41,279
than what we're accustomed to to any

400
00:14:45,670 --> 00:14:43,760
type of system in our own solar system

401
00:14:47,750 --> 00:14:45,680
it's exciting you know it's nice to find

402
00:14:49,910 --> 00:14:47,760
new things um

403
00:14:52,870 --> 00:14:49,920
speaking of which we had a facebook

404
00:14:55,110 --> 00:14:52,880
follower asking um if we plan to send a

405
00:14:56,629 --> 00:14:55,120
probe to this exo moon nicole what do

406
00:14:59,030 --> 00:14:56,639
you think about that oh gosh i mean that

407
00:15:00,949 --> 00:14:59,040
would be amazing if we could do that um

408
00:15:03,509 --> 00:15:00,959
but jennifer mentioned before how far

409
00:15:04,389 --> 00:15:03,519
away it is um it's 8 000 light years

410
00:15:07,189 --> 00:15:04,399
away

411
00:15:09,430 --> 00:15:07,199
which means that even if we could travel

412
00:15:12,949 --> 00:15:09,440
at the speed of light it would take 8

413
00:15:14,790 --> 00:15:12,959

000 years to get there so you know it's

414
00:15:17,350 --> 00:15:14,800
it would be you know one of these

415
00:15:18,710 --> 00:15:17,360
awesome nice to have things but i think

416
00:15:20,710 --> 00:15:18,720
it'll be a while before we have the

417
00:15:22,550 --> 00:15:20,720
technology to be able to send a probe

418
00:15:25,189 --> 00:15:22,560
there unfortunately we don't have warp

419
00:15:27,030 --> 00:15:25,199
drive yet yeah we need warp drives

420
00:15:28,870 --> 00:15:27,040
i continue to send in your questions

421
00:15:32,230 --> 00:15:28,880
we're taking them live from social media

422
00:15:34,230 --> 00:15:32,240
using the hashtag asknasa um

423
00:15:36,710 --> 00:15:34,240
so the next question that i got was from

424
00:15:38,710 --> 00:15:36,720
facebook and somebody asked why should

425
00:15:41,670 --> 00:15:38,720
we be limiting the search for life to

426
00:15:43,110 --> 00:15:41,680
water slash carbon-based planets

427
00:15:44,069 --> 00:15:43,120
very good question

428
00:15:45,590 --> 00:15:44,079
so

429
00:15:48,069 --> 00:15:45,600
um you know

430
00:15:50,629 --> 00:15:48,079
we don't know what we don't know so so

431
00:15:52,550 --> 00:15:50,639
life forms could be very different from

432
00:15:54,310 --> 00:15:52,560
the type of life that we are accustomed

433
00:15:56,230 --> 00:15:54,320
to on planet earth we've all seen a lot

434
00:15:58,310 --> 00:15:56,240
of science fiction

435
00:16:00,629 --> 00:15:58,320
but there are some good reasons to think

436
00:16:02,949 --> 00:16:00,639
that complex life would probably be

437
00:16:05,030 --> 00:16:02,959
carbon based and probably need some

438
00:16:07,110 --> 00:16:05,040

connection to liquid water that's

439
00:16:09,670 --> 00:16:07,120
certainly what we found on planet earth

440
00:16:11,670 --> 00:16:09,680
and we also are able at least from our

441
00:16:14,710 --> 00:16:11,680
experience here to recognize what that

442
00:16:16,790 --> 00:16:14,720
type of life would do to its atmosphere

443
00:16:18,470 --> 00:16:16,800
such that we could detect it from a

444
00:16:20,310 --> 00:16:18,480
distance and look at the atmospheric

445
00:16:22,230 --> 00:16:20,320
characteristics and know that there must

446
00:16:24,230 --> 00:16:22,240
be some kind of biological activity

447
00:16:27,269 --> 00:16:24,240
going on so those are some of the

448
00:16:29,990 --> 00:16:27,279
reasons why it makes sense to look for

449
00:16:32,310 --> 00:16:30,000
life that has some similar basis to the

450
00:16:33,749 --> 00:16:32,320
life forms that we are familiar with on

451
00:16:34,870 --> 00:16:33,759
planet earth

452
00:16:36,949 --> 00:16:34,880
makes sense

453
00:16:38,710 --> 00:16:36,959
um a lot of questions from facebook good

454
00:16:39,430 --> 00:16:38,720
ones um

455
00:16:42,389 --> 00:16:39,440
so

456
00:16:44,629 --> 00:16:42,399
how do we measure how do we go about

457
00:16:47,030 --> 00:16:44,639
measuring the size and distance to an

458
00:16:47,829 --> 00:16:47,040
exoplanet or an exo moon

459
00:16:50,069 --> 00:16:47,839
so

460
00:16:51,269 --> 00:16:50,079
the size is

461
00:17:13,750 --> 00:16:51,279
a

462
00:17:17,189 --> 00:17:13,760
oh one percent of light is blocked which

463
00:17:19,189 --> 00:17:17,199

means some object of some specific size

464
00:17:20,710 --> 00:17:19,199
had to block that size

465
00:17:23,189 --> 00:17:20,720
that amount of light

466
00:17:25,990 --> 00:17:23,199
and so in that case in that way we're

467
00:17:28,390 --> 00:17:26,000
able to measure the radius of the planet

468
00:17:31,830 --> 00:17:28,400
that means we also need to know the size

469
00:17:35,110 --> 00:17:31,840
of the star in order to compare the two

470
00:17:37,190 --> 00:17:35,120
but we can know that from using

471
00:17:38,950 --> 00:17:37,200
observations from even other telescopes

472
00:17:40,630 --> 00:17:38,960
as well so there's like this whole army

473
00:17:42,789 --> 00:17:40,640
of telescopes you need to be able to

474
00:17:44,070 --> 00:17:42,799
really find the planets and measure

475
00:17:45,270 --> 00:17:44,080
their properties

476
00:17:52,630 --> 00:17:45,280
and

477
00:17:54,230 --> 00:17:52,640
was the other part of the question uh so

478
00:17:57,830 --> 00:17:54,240
how we measure the distance there was

479
00:18:01,029 --> 00:17:57,840
actually um an uh mission called gaia

480
00:18:03,669 --> 00:18:01,039
that is recently collecting data to

481
00:18:05,510 --> 00:18:03,679
measure positions of stars in the sky

482
00:18:08,390 --> 00:18:05,520
and based on measuring the positions of

483
00:18:10,950 --> 00:18:08,400
the stars we actually can measure kind

484
00:18:13,909 --> 00:18:10,960
of like this angle of how much they move

485
00:18:15,669 --> 00:18:13,919
and that actually tells us the distance

486
00:18:18,470 --> 00:18:15,679
away from earth so

487
00:18:20,549 --> 00:18:18,480
um it's it's really again an army of

488
00:18:22,870 --> 00:18:20,559

telescopes that operates you know in

489
00:18:25,830 --> 00:18:22,880
concert to provide all this information

490
00:18:27,430 --> 00:18:25,840
to get us the size even mass you know

491
00:18:29,669 --> 00:18:27,440
distance everything

492
00:18:31,510 --> 00:18:29,679
so it's a lot of work but it's it's

493
00:18:33,590 --> 00:18:31,520
definitely worth it we're lucky we have

494
00:18:34,950 --> 00:18:33,600
a great team that's right

495
00:18:36,789 --> 00:18:34,960
um

496
00:18:39,350 --> 00:18:36,799
so we've got another question from

497
00:18:41,990 --> 00:18:39,360
hashtag ask nasa

498
00:18:45,430 --> 00:18:42,000
it is how much stronger is the gravity

499
00:18:47,909 --> 00:18:45,440
on this exo moon compared to than

500
00:18:52,150 --> 00:18:50,070
well that's a very good question i think

501
00:18:54,150 --> 00:18:52,160
i would have to sit and calculate that

502
00:18:57,190 --> 00:18:54,160
out

503
00:19:00,150 --> 00:18:57,200
put you on the spot right on the spot so

504
00:19:00,950 --> 00:19:00,160
um we know that it's mass

505
00:19:02,230 --> 00:19:00,960
uh

506
00:19:05,190 --> 00:19:02,240
the were they asking about the moon or

507
00:19:07,350 --> 00:19:05,200
the planet so um it looks it looks like

508
00:19:08,950 --> 00:19:07,360
compared to earth how much stronger is

509
00:19:09,830 --> 00:19:08,960
the gravity on this exomoon compared to

510
00:19:11,190 --> 00:19:09,840
earth

511
00:19:13,430 --> 00:19:11,200
okay so this

512
00:19:15,270 --> 00:19:13,440
moon is

513
00:19:17,190 --> 00:19:15,280

basically larger than earth it's

514
00:19:18,950 --> 00:19:17,200
basically the size of neptune so it's

515
00:19:20,710 --> 00:19:18,960
going to have a stronger gravitational

516
00:19:22,150 --> 00:19:20,720
field based on the mass difference

517
00:19:23,750 --> 00:19:22,160
between the moon and the earth i can't

518
00:19:26,150 --> 00:19:23,760
actually tell you that because we don't

519
00:19:27,270 --> 00:19:26,160
know for sure the actual mass of this

520
00:19:29,750 --> 00:19:27,280
moon

521
00:19:32,390 --> 00:19:29,760
but it's going to be stronger and it's

522
00:19:34,549 --> 00:19:32,400
also going to be an odd thing to imagine

523
00:19:36,390 --> 00:19:34,559
because it doesn't have a solid surface

524
00:19:37,830 --> 00:19:36,400
so if you're thinking about you know

525
00:19:39,669 --> 00:19:37,840
jumping up and down on this moon like

526
00:19:41,430 --> 00:19:39,679
you might do on earth's moon if you were

527
00:19:44,549 --> 00:19:41,440
an astronaut you're not going to have

528
00:19:46,310 --> 00:19:44,559
the same experience so it's stronger and

529
00:19:47,990 --> 00:19:46,320
that may have actually interesting

530
00:19:49,190 --> 00:19:48,000
implications for the layers of

531
00:19:51,270 --> 00:19:49,200
atmosphere

532
00:19:53,430 --> 00:19:51,280
in this moon so if we have future

533
00:19:54,950 --> 00:19:53,440
telescopes where we can actually

534
00:19:57,270 --> 00:19:54,960
measure the composition of the

535
00:19:59,830 --> 00:19:57,280
atmosphere of this moon and compare it

536
00:20:01,750 --> 00:19:59,840
to let's say planets and our own gaseous

537
00:20:04,149 --> 00:20:01,760
planets in our own solar system we may

538
00:20:06,549 --> 00:20:04,159

be able to understand something about

539
00:20:08,549 --> 00:20:06,559
how that moon has been formed what its

540
00:20:11,029 --> 00:20:08,559
nature is and how that strong

541
00:20:12,230 --> 00:20:11,039
gravitational field is affecting how the

542
00:20:15,830 --> 00:20:12,240
layers of

543
00:20:17,909 --> 00:20:15,840
of gases are arranging themselves in

544
00:20:19,669 --> 00:20:17,919
this moon so i look forward to being

545
00:20:21,990 --> 00:20:19,679
able to understand the effects of the

546
00:20:24,310 --> 00:20:22,000
gravitational field and maybe even a

547
00:20:25,990 --> 00:20:24,320
magnetic field when we have future

548
00:20:27,270 --> 00:20:26,000
observations

549
00:20:30,470 --> 00:20:27,280
so we're just going to have to wait and

550
00:20:32,230 --> 00:20:30,480
see for a lot of these questions

551
00:20:33,750 --> 00:20:32,240
so this is actually a really interesting

552
00:20:36,870 --> 00:20:33,760
question

553
00:20:39,750 --> 00:20:36,880
if our own earth was this far away would

554
00:20:42,070 --> 00:20:39,760
we be able to detect it

555
00:20:45,750 --> 00:20:42,080
so if our earth was like 8 000 light

556
00:20:47,750 --> 00:20:45,760
years away i guess at the same distance

557
00:20:49,830 --> 00:20:47,760
that's a good question it

558
00:20:51,990 --> 00:20:49,840
so the initial

559
00:20:54,390 --> 00:20:52,000
planet that that this moon orbits around

560
00:20:56,870 --> 00:20:54,400
is a jupiter-sized planet which is

561
00:20:59,350 --> 00:20:56,880
something like 10 11 12 times the size

562
00:21:00,870 --> 00:20:59,360
of earth so it causes a pretty large dip

563
00:21:02,950 --> 00:21:00,880

in light

564
00:21:06,470 --> 00:21:02,960
so the earth being that much smaller

565
00:21:08,390 --> 00:21:06,480
would cause a much smaller dip um like a

566
00:21:11,750 --> 00:21:08,400
tenth of of what

567
00:21:13,990 --> 00:21:11,760
um that jupiter causes so

568
00:21:16,310 --> 00:21:14,000
we would basically need you know very

569
00:21:19,270 --> 00:21:16,320
very precise instruments and kepler did

570
00:21:20,789 --> 00:21:19,280
discover um several earth-sized

571
00:21:23,350 --> 00:21:20,799
exoplanets

572
00:21:24,470 --> 00:21:23,360
um but then to have you know an exomoon

573
00:21:25,830 --> 00:21:24,480
around it

574
00:21:26,710 --> 00:21:25,840
that's something we haven't discovered

575
00:21:28,710 --> 00:21:26,720
yet

576
00:21:30,710 --> 00:21:28,720
so you know there's

577
00:21:33,510 --> 00:21:30,720
it's tricky

578
00:21:34,470 --> 00:21:33,520
is the answer um it depends on a lot of

579
00:21:36,950 --> 00:21:34,480
things

580
00:21:38,789 --> 00:21:36,960
but you know it's not um

581
00:21:40,470 --> 00:21:38,799
it's not impossible you just need to

582
00:21:43,350 --> 00:21:40,480
make sure you have the right you know

583
00:21:45,590 --> 00:21:43,360
telescope basically

584
00:21:47,990 --> 00:21:45,600
okay um let's

585
00:21:50,950 --> 00:21:49,270
continue sending your questions into

586
00:21:52,870 --> 00:21:50,960
hashtag ask nasa by the way we will get

587
00:21:56,390 --> 00:21:52,880
to as many as we can and we'll get to

588
00:21:58,230 --> 00:21:56,400

some after the show too i'm sure um so

589
00:21:59,430 --> 00:21:58,240
how does the gravity well we already

590
00:22:01,830 --> 00:21:59,440
discussed gravity how's the

591
00:22:03,430 --> 00:22:01,840
electromagnetic field of that exomoon

592
00:22:05,590 --> 00:22:03,440
compared to earth do we do we even have

593
00:22:07,510 --> 00:22:05,600
any information on that yet

594
00:22:09,750 --> 00:22:07,520
well that's a that's a great question

595
00:22:11,350 --> 00:22:09,760
because that would impact all kinds of

596
00:22:13,350 --> 00:22:11,360
things about the environment about that

597
00:22:15,190 --> 00:22:13,360
exomoon so

598
00:22:17,350 --> 00:22:15,200
we don't have a lot of information about

599
00:22:20,070 --> 00:22:17,360
this whole system but as as i mentioned

600
00:22:23,830 --> 00:22:20,080
earlier we think that the star that this

601
00:22:26,549 --> 00:22:23,840
planet and potential moon are orbiting

602
00:22:27,909 --> 00:22:26,559
is not too different from our sun so

603
00:22:29,750 --> 00:22:27,919
it's going to have some of those same

604
00:22:31,909 --> 00:22:29,760
characteristics of the sun which would

605
00:22:35,350 --> 00:22:31,919
include magnetic field activity that

606
00:22:38,149 --> 00:22:35,360
might in fact interact occasionally the

607
00:22:40,310 --> 00:22:38,159
the stellar activity may interact with

608
00:22:42,230 --> 00:22:40,320
this planet and its moon its system just

609
00:22:44,549 --> 00:22:42,240
the same way as our sun has certain

610
00:22:46,230 --> 00:22:44,559
activity flares and so forth that

611
00:22:47,909 --> 00:22:46,240
interact with our

612
00:22:51,510 --> 00:22:47,919
earth moon system

613
00:22:53,590 --> 00:22:51,520

and then it's quite possible that this

614
00:22:55,830 --> 00:22:53,600
planet that this moon is associated with

615
00:22:58,230 --> 00:22:55,840
would have a magnetic field that

616
00:23:00,630 --> 00:22:58,240
magnetic field would impact

617
00:23:02,870 --> 00:23:00,640
its moon and it would affect the

618
00:23:05,909 --> 00:23:02,880
environment there that would infect how

619
00:23:07,830 --> 00:23:05,919
that system is interacting with flares

620
00:23:10,549 --> 00:23:07,840
and particles cosmic rays coming from

621
00:23:12,710 --> 00:23:10,559
its parent star so we don't know yet

622
00:23:14,390 --> 00:23:12,720
what the magnetic field might be around

623
00:23:17,190 --> 00:23:14,400
that system we know it's going to get

624
00:23:20,070 --> 00:23:17,200
the same you know ballpark radiation

625
00:23:20,950 --> 00:23:20,080
from its parent star as we get from the

626
00:23:23,350 --> 00:23:20,960
sun

627
00:23:25,750 --> 00:23:23,360
in our earth moon system

628
00:23:28,789 --> 00:23:25,760
and this will impact whether there is

629
00:23:29,990 --> 00:23:28,799
any sort of habitability in this region

630
00:23:32,149 --> 00:23:30,000
at the very least it will be very

631
00:23:33,909 --> 00:23:32,159
interesting to study so i'm just

632
00:23:36,470 --> 00:23:33,919
we keep talking about future telescopes

633
00:23:38,950 --> 00:23:36,480
but i'm i'm very keen about this

634
00:23:41,909 --> 00:23:38,960
direction of astronomy because we are

635
00:23:44,549 --> 00:23:41,919
using the telescopes we have like hubble

636
00:23:46,310 --> 00:23:44,559
and soon tests to learn what we can but

637
00:23:48,070 --> 00:23:46,320
future telescopes like the james webb

638
00:23:50,230 --> 00:23:48,080

space telescope

639
00:23:52,870 --> 00:23:50,240
are going to be able to give us more

640
00:23:55,990 --> 00:23:52,880
details about the nature of

641
00:23:57,669 --> 00:23:56,000
this exoplanet system and others

642
00:23:59,830 --> 00:23:57,679
and the environments around them and

643
00:24:01,590 --> 00:23:59,840
what their moons might be like in terms

644
00:24:03,430 --> 00:24:01,600
of their interactions with magnetic

645
00:24:04,950 --> 00:24:03,440
fields with radiation

646
00:24:07,110 --> 00:24:04,960
temperatures

647
00:24:09,669 --> 00:24:07,120
all kinds of things so this is just the

648
00:24:12,070 --> 00:24:09,679
beginning of our investigation into this

649
00:24:14,549 --> 00:24:12,080
whole type of object

650
00:24:15,510 --> 00:24:14,559
it's a new science

651
00:24:16,470 --> 00:24:15,520
so

652
00:24:20,630 --> 00:24:16,480
this is

653
00:24:23,269 --> 00:24:20,640
may be a little bit difficult uh

654
00:24:24,789 --> 00:24:23,279
is it possible that this moon could have

655
00:24:27,029 --> 00:24:24,799
its own moons

656
00:24:30,630 --> 00:24:27,039
oh that is a great question

657
00:24:32,390 --> 00:24:30,640
and a difficult one um well first it i

658
00:24:34,549 --> 00:24:32,400
mean i'll say anything's possible you

659
00:24:36,950 --> 00:24:34,559
know as we've been discovering all kinds

660
00:24:39,909 --> 00:24:36,960
of exoplanets first of all things that

661
00:24:41,669 --> 00:24:39,919
we didn't know could exist um that orbit

662
00:24:43,510 --> 00:24:41,679
so close to their star that you know

663
00:24:45,510 --> 00:24:43,520

they orbit within one day compared to

664
00:24:47,430 --> 00:24:45,520
our one-year orbit so things like this

665
00:24:48,549 --> 00:24:47,440
that we'd never even dreamed of

666
00:24:51,590 --> 00:24:48,559
so

667
00:24:54,149 --> 00:24:51,600
an an exo moon having its own moons is

668
00:24:56,549 --> 00:24:54,159
possible especially when

669
00:24:58,390 --> 00:24:56,559
this moon is so massive that maybe it

670
00:25:00,789 --> 00:24:58,400
could what we call you know use its

671
00:25:01,990 --> 00:25:00,799
gravity to capture other smaller bodies

672
00:25:04,310 --> 00:25:02,000
around it

673
00:25:06,870 --> 00:25:04,320
like mars has two very tiny moons

674
00:25:09,430 --> 00:25:06,880
relatively speaking compared to our moon

675
00:25:11,430 --> 00:25:09,440
so maybe there's some very tiny moons

676
00:25:13,669 --> 00:25:11,440
that have been captured by this moon and

677
00:25:15,350 --> 00:25:13,679
are orbiting but we just don't have the

678
00:25:18,149 --> 00:25:15,360
right instruments to be able to detect

679
00:25:20,710 --> 00:25:18,159
them right now um and yeah but it's

680
00:25:22,470 --> 00:25:20,720
definitely uh possible

681
00:25:23,269 --> 00:25:22,480
that could be cool

682
00:25:24,870 --> 00:25:23,279
so

683
00:25:26,070 --> 00:25:24,880
we've been talking about hubble and

684
00:25:28,070 --> 00:25:26,080
we've been talking about nasa's

685
00:25:29,830 --> 00:25:28,080
anniversary and

686
00:25:31,909 --> 00:25:29,840
so nasa's been around for 60 years and

687
00:25:34,390 --> 00:25:31,919
hubble's been around for almost half

688
00:25:36,630 --> 00:25:34,400

that time how's our telescope doing

689
00:25:38,630 --> 00:25:36,640
well we're excited about hubble so as

690
00:25:40,390 --> 00:25:38,640
you say hubble's been around almost half

691
00:25:43,269 --> 00:25:40,400
the time that nasa's been around and we

692
00:25:46,230 --> 00:25:43,279
just celebrated hubble's 28th

693
00:25:47,909 --> 00:25:46,240
birthday um earlier this year

694
00:25:50,310 --> 00:25:47,919
hubble's been working well because we

695
00:25:52,549 --> 00:25:50,320
have this terrific crew of people on the

696
00:25:54,549 --> 00:25:52,559
ground that are keeping it

697
00:25:57,029 --> 00:25:54,559
strong scientifically working and we've

698
00:25:58,070 --> 00:25:57,039
had several crews of astronauts over the

699
00:26:00,310 --> 00:25:58,080
years

700
00:26:02,149 --> 00:26:00,320
coming back to

701
00:26:04,310 --> 00:26:02,159
upgrade the telescope and service it

702
00:26:06,710 --> 00:26:04,320
keeping it in tip-top shape so

703
00:26:08,789 --> 00:26:06,720
hubble is in great shape we're getting

704
00:26:11,430 --> 00:26:08,799
some of the best science out of it now

705
00:26:13,350 --> 00:26:11,440
than ever before in its history we're

706
00:26:15,190 --> 00:26:13,360
learning not only about the atmospheres

707
00:26:17,190 --> 00:26:15,200
of some exoplanets but we're also

708
00:26:18,950 --> 00:26:17,200
learning about star systems other

709
00:26:20,789 --> 00:26:18,960
galaxies even the whole universe the

710
00:26:22,390 --> 00:26:20,799
history of the universe and we

711
00:26:24,870 --> 00:26:22,400
anticipate getting good science from

712
00:26:27,269 --> 00:26:24,880
hubble for quite a few years to come

713
00:26:29,190 --> 00:26:27,279

in fact we are hoping that we overlap

714
00:26:31,750 --> 00:26:29,200
with the james webb space telescope

715
00:26:33,669 --> 00:26:31,760
which will launch in 2021

716
00:26:35,029 --> 00:26:33,679
and overlap with that telescope for

717
00:26:36,870 --> 00:26:35,039
several years because these

718
00:26:38,710 --> 00:26:36,880
complementary observatories are going to

719
00:26:41,990 --> 00:26:38,720
give us terrific science they're going

720
00:26:44,310 --> 00:26:42,000
to cover the wavelength range of light

721
00:26:46,390 --> 00:26:44,320
from mid infrared all the way through

722
00:26:47,909 --> 00:26:46,400
the visible colors that our eyes can see

723
00:26:50,710 --> 00:26:47,919
and on into the higher energy

724
00:26:52,470 --> 00:26:50,720
ultraviolet light this gives us a great

725
00:26:54,950 --> 00:26:52,480
deal of information about whatever we're

726
00:26:55,750 --> 00:26:54,960
studying whether it's exoplanets

727
00:26:58,390 --> 00:26:55,760
or

728
00:26:59,990 --> 00:26:58,400
planets planets in our own solar system

729
00:27:02,390 --> 00:27:00,000
and and of course other stars and

730
00:27:04,230 --> 00:27:02,400
galaxies and we complement other

731
00:27:06,390 --> 00:27:04,240
missions you know hubble is being used

732
00:27:08,789 --> 00:27:06,400
to complement the information that we're

733
00:27:10,630 --> 00:27:08,799
getting from probes that we're sending

734
00:27:12,870 --> 00:27:10,640
within our own solar system for example

735
00:27:14,470 --> 00:27:12,880
the juno probe studying

736
00:27:15,990 --> 00:27:14,480
jupiter in our own solar system is

737
00:27:17,669 --> 00:27:16,000
sending back information that we're

738
00:27:20,549 --> 00:27:17,679

correlating with observations from

739
00:27:22,870 --> 00:27:20,559
hubble we're using we've used it along

740
00:27:24,870 --> 00:27:22,880
with new horizons to study

741
00:27:26,950 --> 00:27:24,880
pluto we're using it with other missions

742
00:27:29,909 --> 00:27:26,960
to study things outside of our solar

743
00:27:31,990 --> 00:27:29,919
system and in in in the deep universe

744
00:27:33,510 --> 00:27:32,000
so i think hubble is in great shape and

745
00:27:35,190 --> 00:27:33,520
will be for quite a few years to come

746
00:27:37,510 --> 00:27:35,200
and that makes me very happy that makes

747
00:27:40,070 --> 00:27:37,520
me very happy but unfortunately this is

748
00:27:41,669 --> 00:27:40,080
the end of the show um

749
00:27:44,149 --> 00:27:41,679
if you want to know more about hubble or

750
00:27:46,389 --> 00:27:44,159
about this exo moon you can go to our

751
00:27:47,909 --> 00:27:46,399
website nas.gov hubble we got a bunch of

752
00:27:50,630 --> 00:27:47,919
great new products up there we've got an

753
00:27:52,630 --> 00:27:50,640
interactive timeline that you can see

754
00:27:54,789 --> 00:27:52,640
hubble milestones you can check out a

755
00:27:56,470 --> 00:27:54,799
360 tour of our space telescope

756
00:27:58,230 --> 00:27:56,480
operations control room you can see

757
00:28:00,630 --> 00:27:58,240
where all the action happens and we've

758
00:28:02,870 --> 00:28:00,640
uploaded hours of hubble historical

759
00:28:04,950 --> 00:28:02,880
video for you to check out so head to

760
00:28:07,190 --> 00:28:04,960
nasa.gov hubble or you can find us on

761
00:28:08,710 --> 00:28:07,200
social media at nasa hubble and