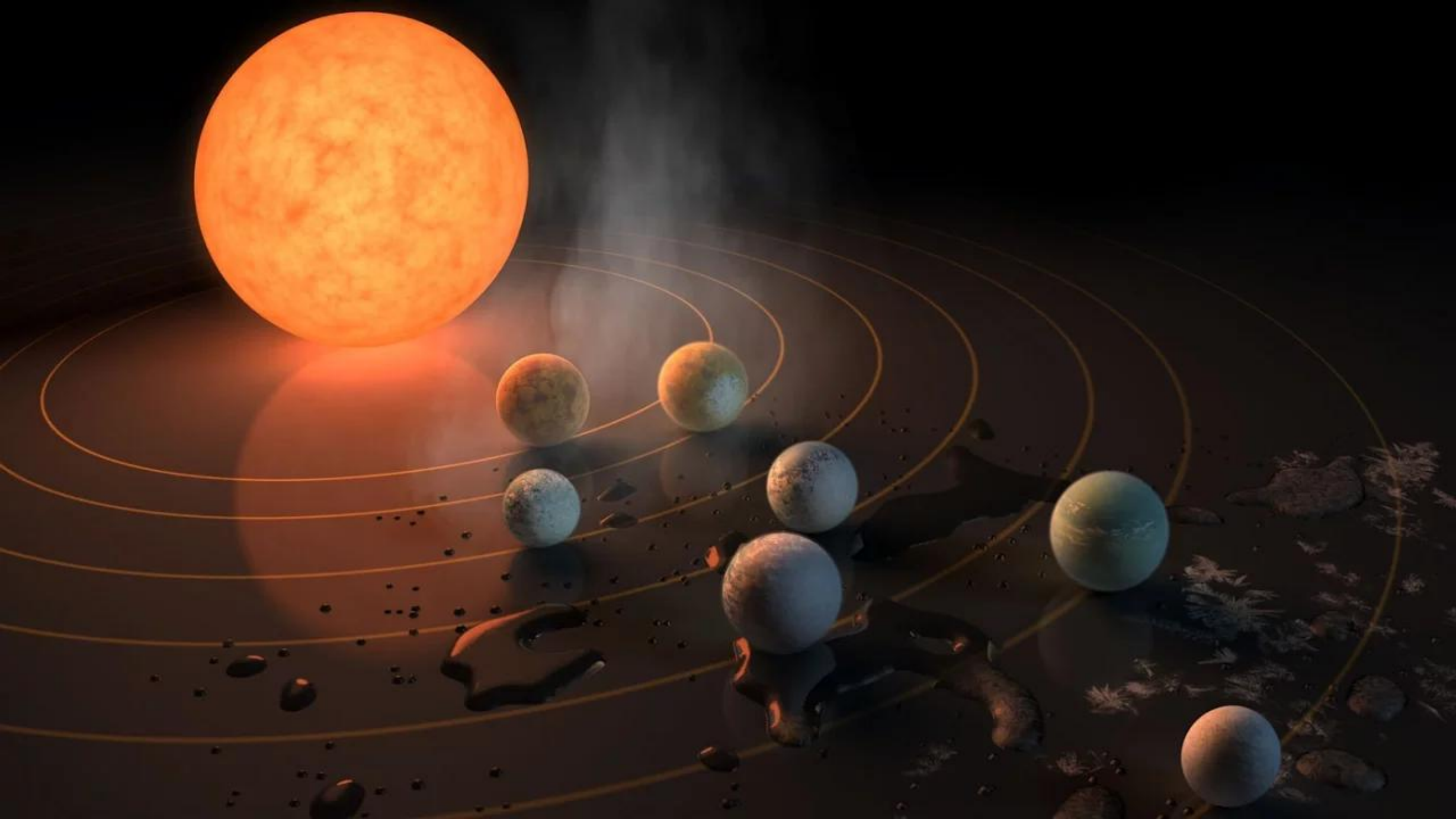

1
00:00:04,230 --> 00:00:02,470
good afternoon i'm felicia chao from the

2
00:00:06,309 --> 00:00:04,240
office of communications and we're live

3
00:00:08,390 --> 00:00:06,319
here at nasa headquarters we've got some

4
00:00:10,549 --> 00:00:08,400
exciting news on worlds outside of our

5
00:00:11,990 --> 00:00:10,559
solar system today first we'll have

6
00:00:13,910 --> 00:00:12,000
brief presentations from all of our

7
00:00:15,669 --> 00:00:13,920
panelists and then we're going to answer

8
00:00:18,230 --> 00:00:15,679
questions from those in the studio on

9
00:00:20,470 --> 00:00:18,240
the phone and on social media to ask a

10
00:00:23,029 --> 00:00:20,480
question via social media please use the

11
00:00:25,109 --> 00:00:23,039
hashtag asknasa

12
00:00:27,349 --> 00:00:25,119
today's participants are

13
00:00:29,269 --> 00:00:27,359

thomas zerbukin

14
00:00:31,429 --> 00:00:29,279
associate administrator of the science

15
00:00:33,670 --> 00:00:31,439
mission directorate at nasa headquarters

16
00:00:35,910 --> 00:00:33,680
in washington

17
00:00:39,670 --> 00:00:35,920
mikhail jilan astronomer at the

18
00:00:42,549 --> 00:00:39,680
university of liege in belgium

19
00:00:45,270 --> 00:00:42,559
sean carey manager of nasa's spitzer

20
00:00:48,950 --> 00:00:45,280
science center at caltech ipac in

21
00:00:53,110 --> 00:00:51,190
sarah seeger professor of planetary

22
00:00:56,470 --> 00:00:53,120
science and physics at massachusetts

23
00:00:59,430 --> 00:00:56,480
institute of technology in cambridge

24
00:01:02,630 --> 00:00:59,440
and nicole lewis astronomer at the space

25
00:01:05,030 --> 00:01:02,640
telescope science institute in baltimore

26
00:01:07,670 --> 00:01:05,040
and with that thomas can you start us

27
00:01:09,750 --> 00:01:07,680
off with what the big news of the day is

28
00:01:12,070 --> 00:01:09,760
hey thanks so much fellow shot look i've

29
00:01:13,830 --> 00:01:12,080
been associate administrator for the

30
00:01:14,950 --> 00:01:13,840
science mission director for close to

31
00:01:17,830 --> 00:01:14,960
five

32
00:01:20,149 --> 00:01:17,840
months and i've just been in awe and i

33
00:01:21,749 --> 00:01:20,159
mean not today about both the depth and

34
00:01:24,149 --> 00:01:21,759
the breadth of the science that we do

35
00:01:26,390 --> 00:01:24,159
here we're changing people's lives every

36
00:01:28,710 --> 00:01:26,400
day and we enlarge in the space we know

37
00:01:31,910 --> 00:01:28,720
we stretch our imagination we inspire

38
00:01:34,310 --> 00:01:31,920

every day and today's story is just that

39
00:01:36,630 --> 00:01:34,320
i'm excited to announce today that dr

40
00:01:39,429 --> 00:01:36,640
mikhail jiang and his team

41
00:01:41,350 --> 00:01:39,439
have used our spitzer space telescope to

42
00:01:43,990 --> 00:01:41,360
determine that there are actually seven

43
00:01:46,710 --> 00:01:44,000
earth-sized planets orbiting the nearby

44
00:01:47,990 --> 00:01:46,720
trappist-1 star about 40 light years

45
00:01:50,069 --> 00:01:48,000
away

46
00:01:51,510 --> 00:01:50,079
what's more as you can see in this

47
00:01:53,910 --> 00:01:51,520
illustration

48
00:01:56,630 --> 00:01:53,920
is that three of these planets marked in

49
00:01:59,670 --> 00:01:56,640
green are in the habitable zone where

50
00:02:00,950 --> 00:01:59,680
liquid water can pool on the surface in

51
00:02:03,190 --> 00:02:00,960
fact with the right atmospheric

52
00:02:05,190 --> 00:02:03,200
conditions there could be water on any

53
00:02:07,749 --> 00:02:05,200
of these planets

54
00:02:10,309 --> 00:02:07,759
so for the first time we found as many

55
00:02:12,229 --> 00:02:10,319
terrestrial planets around a single

56
00:02:14,229 --> 00:02:12,239
star and that's the first time we have

57
00:02:17,270 --> 00:02:14,239
been able to measure in addition to that

58
00:02:19,430 --> 00:02:17,280
both the masses and the radii of these

59
00:02:22,070 --> 00:02:19,440
habitable zone type

60
00:02:23,910 --> 00:02:22,080
earth-sized planets these planets are

61
00:02:26,309 --> 00:02:23,920
among the best

62
00:02:29,030 --> 00:02:26,319
uh in in of all the planets we know to

63
00:02:30,630 --> 00:02:29,040

follow up to see for example with the

64
00:02:32,630 --> 00:02:30,640
james webb space telescope that we're

65
00:02:34,790 --> 00:02:32,640
going to launch last year the

66
00:02:36,869 --> 00:02:34,800
atmospheres and also to look at bio

67
00:02:39,190 --> 00:02:36,879
signatures if there are any

68
00:02:41,670 --> 00:02:39,200
the discovery gives us a hint

69
00:02:43,910 --> 00:02:41,680
that finding a second earth

70
00:02:45,830 --> 00:02:43,920
is not just a matter of if

71
00:02:48,229 --> 00:02:45,840
but when

72
00:02:50,070 --> 00:02:48,239
scientists believe actually that

73
00:02:53,030 --> 00:02:50,080
around every star that could be one

74
00:02:55,589 --> 00:02:53,040
planet take three take five take seven

75
00:02:58,070 --> 00:02:55,599
and you can just imagine how many worlds

76
00:03:00,550 --> 00:02:58,080
are out there that have a shot to

77
00:03:03,030 --> 00:03:00,560
becoming a habitable ecosystem that we

78
00:03:05,910 --> 00:03:03,040
could explore

79
00:03:08,470 --> 00:03:05,920
and what we really have in this story is

80
00:03:10,470 --> 00:03:08,480
a major step forward towards answering

81
00:03:13,750 --> 00:03:10,480
one of these very questions that are at

82
00:03:15,750 --> 00:03:13,760
the heart of so many of our philosophers

83
00:03:18,070 --> 00:03:15,760
of what we're thinking about when we're

84
00:03:20,710 --> 00:03:18,080
by ourselves and that basically is are

85
00:03:23,190 --> 00:03:20,720
we alone out there we're making a step

86
00:03:25,670 --> 00:03:23,200
forward with this a leap forward in fact

87
00:03:27,190 --> 00:03:25,680
towards answering that question and i'm

88
00:03:29,589 --> 00:03:27,200

really excited

89
00:03:30,869 --> 00:03:29,599
for you to hear about it now

90
00:03:33,350 --> 00:03:30,879
thanks thomas

91
00:03:37,030 --> 00:03:33,360
so mikael can you tell us more about

92
00:03:40,309 --> 00:03:37,040
this finding sure as thomas mentioned we

93
00:03:43,350 --> 00:03:40,319
used a spitzer space telescope with over

94
00:03:45,670 --> 00:03:43,360
ground-based telescope to discover

95
00:03:49,110 --> 00:03:45,680
around the same star not one

96
00:03:51,350 --> 00:03:49,120
not two but seven earth-sized planets

97
00:03:53,350 --> 00:03:51,360
and this is the first time that uh so

98
00:03:55,350 --> 00:03:53,360
many her-sized planets are found around

99
00:03:57,589 --> 00:03:55,360
the same star furthermore with three of

100
00:03:59,830 --> 00:03:57,599
them in the habitable zone

101
00:04:02,470 --> 00:03:59,840
and the star itself is what is called a

102
00:04:05,429 --> 00:04:02,480
neurtua cool dwarf which is the least

103
00:04:07,990 --> 00:04:05,439
massive kind of stars that exist and

104
00:04:09,270 --> 00:04:08,000
these stars are much smaller much cooler

105
00:04:11,509 --> 00:04:09,280
than our sun

106
00:04:13,270 --> 00:04:11,519
and still they are very frequent in at

107
00:04:15,429 --> 00:04:13,280
the scale of our galaxy more frequent

108
00:04:18,069 --> 00:04:15,439
than solar type stars

109
00:04:19,509 --> 00:04:18,079
and if you look at this illustration you

110
00:04:22,550 --> 00:04:19,519
see the comparison between the

111
00:04:25,110 --> 00:04:22,560
basketball and the golf ball well in our

112
00:04:27,990 --> 00:04:25,120
case the basketball would be the sun and

113
00:04:30,629 --> 00:04:28,000

the golf ball it would be trappist one

114
00:04:33,189 --> 00:04:30,639
so trappist-1 is much cooler much

115
00:04:35,350 --> 00:04:33,199
smaller than our sun and so the planets

116
00:04:37,830 --> 00:04:35,360
it's in its habitable zone are much

117
00:04:39,909 --> 00:04:37,840
closer to it very close to it with very

118
00:04:42,790 --> 00:04:39,919
short orbital periods

119
00:04:45,350 --> 00:04:42,800
and in the this graphics what you can

120
00:04:47,030 --> 00:04:45,360
see are the planets uh which are around

121
00:04:48,629 --> 00:04:47,040
which we have found around trapeze one

122
00:04:51,110 --> 00:04:48,639
with the three of them which are in the

123
00:04:54,390 --> 00:04:51,120
habitable zone so also called the gold

124
00:04:56,870 --> 00:04:54,400
deluxe zones where liquid water could

125
00:04:59,350 --> 00:04:56,880
exist is the most likely to exist at the

126
00:05:01,189 --> 00:04:59,360
surface of a rocky planet having free of

127
00:05:03,350 --> 00:05:01,199
this earth-sized planet in this

128
00:05:05,030 --> 00:05:03,360
habitable zone it's very promising for

129
00:05:06,150 --> 00:05:05,040
the search for life beyond our solar

130
00:05:07,830 --> 00:05:06,160
system

131
00:05:09,510 --> 00:05:07,840
so what can you tell us about these

132
00:05:12,469 --> 00:05:09,520
distant planets

133
00:05:14,870 --> 00:05:12,479
well we have missouri with spitzer very

134
00:05:17,670 --> 00:05:14,880
very precisely these sizes and

135
00:05:20,790 --> 00:05:17,680
furthermore we have thanks to spitzer 2

136
00:05:22,230 --> 00:05:20,800
a preliminary measurements of the masses

137
00:05:24,629 --> 00:05:22,240
for six of them

138
00:05:27,670 --> 00:05:24,639

and for one of them our messer man is

139
00:05:30,230 --> 00:05:27,680
precise enough to strongly suggest a

140
00:05:31,430 --> 00:05:30,240
water-rich composition which is very

141
00:05:33,510 --> 00:05:31,440
exciting because this is one of the

142
00:05:36,150 --> 00:05:33,520
plant in the habitable zone

143
00:05:38,230 --> 00:05:36,160
furthermore these planets are orbiting

144
00:05:40,469 --> 00:05:38,240
so close to the stars that they must be

145
00:05:43,029 --> 00:05:40,479
or they are probably tidally locked

146
00:05:45,590 --> 00:05:43,039
which means they always face the star

147
00:05:48,390 --> 00:05:45,600
with the same sight like the moon to the

148
00:05:51,749 --> 00:05:48,400
earth and so if you look at this

149
00:05:53,510 --> 00:05:51,759
animation you can see a view of tidally

150
00:05:55,590 --> 00:05:53,520
locked planet with a permanent on this

151
00:05:57,430 --> 00:05:55,600
side and a permanent nine site the

152
00:05:58,629 --> 00:05:57,440
trappist-1 planet could be just like

153
00:06:00,310 --> 00:05:58,639
this

154
00:06:02,230 --> 00:06:00,320
now what is also exciting here about

155
00:06:04,870 --> 00:06:02,240
this system is that the planet are so

156
00:06:07,029 --> 00:06:04,880
close to each other if you wear on the

157
00:06:09,350 --> 00:06:07,039
surface of one of this planet you would

158
00:06:11,430 --> 00:06:09,360
have a wonderful view on the other

159
00:06:14,469 --> 00:06:11,440
planets you wouldn't see them

160
00:06:16,870 --> 00:06:14,479
like we see venus or mars like dots of

161
00:06:19,510 --> 00:06:16,880
light but as you can see in the next

162
00:06:21,909 --> 00:06:19,520
illustration you would see them really

163
00:06:24,150 --> 00:06:21,919

as we see the moon you would see walls

164
00:06:25,990 --> 00:06:24,160
with uh which are very big you could see

165
00:06:28,550 --> 00:06:26,000
the structures on these walls they would

166
00:06:31,830 --> 00:06:28,560
be as large as the moon and even

167
00:06:34,629 --> 00:06:31,840
larger for some of them so it would be a

168
00:06:37,430 --> 00:06:34,639
wonderful view on these planets

169
00:06:40,230 --> 00:06:37,440
thanks mikel so sean can you give us an

170
00:06:42,629 --> 00:06:40,240
idea or more context to discovery and

171
00:06:44,629 --> 00:06:42,639
why spitzer played such a vital role

172
00:06:46,550 --> 00:06:44,639
absolutely felicia i first like to say

173
00:06:48,710 --> 00:06:46,560
that i my opinion this is the most

174
00:06:50,629 --> 00:06:48,720
exciting discovery we've had yet with

175
00:06:52,790 --> 00:06:50,639
spitzer and it's 14 years almost 14

176
00:06:54,790 --> 00:06:52,800
years of operation as you can see in the

177
00:06:56,629 --> 00:06:54,800
graphic uh the initial discovery of the

178
00:06:59,749 --> 00:06:56,639
trappist-1 system was by the trappist

179
00:07:01,029 --> 00:06:59,759
telescope in chile in 2016 and it

180
00:07:02,309 --> 00:07:01,039
immediately after that we started doing

181
00:07:04,629 --> 00:07:02,319
intensive follow-up with a lot of

182
00:07:05,909 --> 00:07:04,639
ground-based telescopes and more than 20

183
00:07:07,830 --> 00:07:05,919
days of observing continuous

184
00:07:09,670 --> 00:07:07,840
observations with spitzer and what we're

185
00:07:10,950 --> 00:07:09,680
able to find is that we confirmed two of

186
00:07:13,430 --> 00:07:10,960
the planets that were found in the

187
00:07:15,270 --> 00:07:13,440
initial discovery and then found five

188
00:07:16,870 --> 00:07:15,280

more planets for a total of seven

189
00:07:18,469 --> 00:07:16,880
planets in the system which is which is

190
00:07:21,430 --> 00:07:18,479
pretty exciting

191
00:07:23,749 --> 00:07:21,440
now trappist-1 is an ultra-cool dwarf

192
00:07:25,350 --> 00:07:23,759
and that means that it's much brighter

193
00:07:26,710 --> 00:07:25,360
in the infrared thousands of times

194
00:07:28,390 --> 00:07:26,720
brighter in the infrared than invisible

195
00:07:30,230 --> 00:07:28,400
so it makes it ideal to use spitzer

196
00:07:32,150 --> 00:07:30,240
which is an infrared telescope to do the

197
00:07:33,189 --> 00:07:32,160
follow-up on this system

198
00:07:35,110 --> 00:07:33,199
and then as you can see in this

199
00:07:37,830 --> 00:07:35,120
animation of spitzer

200
00:07:39,270 --> 00:07:37,840
so spitzer was was launched in 2003 and

201
00:07:41,510 --> 00:07:39,280
it was never intended to study

202
00:07:43,589 --> 00:07:41,520
exoplanets so we had to do some clever

203
00:07:45,589 --> 00:07:43,599
re-engineering why it's in space still

204
00:07:47,510 --> 00:07:45,599
and it's more than an astronomical unit

205
00:07:49,110 --> 00:07:47,520
away from from the earth so you can't

206
00:07:51,749 --> 00:07:49,120
fly out and do anything about but we did

207
00:07:54,550 --> 00:07:51,759
equivalent engineering on the ground to

208
00:07:56,550 --> 00:07:54,560
come up allow spitzer to measure star

209
00:07:58,070 --> 00:07:56,560
brightness is very precisely a thousand

210
00:08:00,710 --> 00:07:58,080
times more precisely than we had

211
00:08:01,830 --> 00:08:00,720
imagined spitzer would be able to do

212
00:08:05,189 --> 00:08:01,840
and then what we're going to show in the

213
00:08:06,790 --> 00:08:05,199

next animation is how when spitzer sees

214
00:08:08,469 --> 00:08:06,800
the planets very similar to the way the

215
00:08:10,070 --> 00:08:08,479
kepler space telescope does we don't

216
00:08:12,230 --> 00:08:10,080
image the individual planets what we do

217
00:08:14,469 --> 00:08:12,240
is the planets pass in front of the star

218
00:08:16,550 --> 00:08:14,479
we see the amount of white that the star

219
00:08:18,629 --> 00:08:16,560
is dim by when that planet is blocking

220
00:08:20,070 --> 00:08:18,639
it so the dips you see in this animation

221
00:08:22,309 --> 00:08:20,080
are the planets going in front of the

222
00:08:24,469 --> 00:08:22,319
star blocking a little bit of the white

223
00:08:26,390 --> 00:08:24,479
the size of the dip tells you the size

224
00:08:27,990 --> 00:08:26,400
of the planet so we can get the size of

225
00:08:29,990 --> 00:08:28,000
the planet directly from measuring the

226
00:08:31,749 --> 00:08:30,000
dip now when you see the different

227
00:08:33,589 --> 00:08:31,759
planets they keep orbiting around and

228
00:08:35,190 --> 00:08:33,599
around and every time they transit you

229
00:08:36,630 --> 00:08:35,200
can measure the spacing between the

230
00:08:38,709 --> 00:08:36,640
transits and that tells you about the

231
00:08:41,509 --> 00:08:38,719
orbit the period of the orbit how long

232
00:08:43,750 --> 00:08:41,519
that year is and once we for that planet

233
00:08:45,110 --> 00:08:43,760
and then when we know

234
00:08:46,870 --> 00:08:45,120
how long it takes for the planet to go

235
00:08:48,870 --> 00:08:46,880
around the star we also know the

236
00:08:50,070 --> 00:08:48,880
distance it is from the star and it also

237
00:08:51,509 --> 00:08:50,080
tells us whether or not it's in the

238
00:08:53,110 --> 00:08:51,519

habitable zone

239
00:08:54,470 --> 00:08:53,120
now the trappist-1 system and its

240
00:08:55,990 --> 00:08:54,480
planets are in an interesting

241
00:08:57,910 --> 00:08:56,000
configuration the planets are all very

242
00:08:59,670 --> 00:08:57,920
close together and their orbits are

243
00:09:01,430 --> 00:08:59,680
space such that they gravitationally

244
00:09:03,670 --> 00:09:01,440
interact with each other they tug and

245
00:09:05,670 --> 00:09:03,680
pull each other as they go flying around

246
00:09:07,350 --> 00:09:05,680
orbiting around their star and what that

247
00:09:08,790 --> 00:09:07,360
does is it changes the timing of the

248
00:09:10,870 --> 00:09:08,800
transits a little bit as the planets are

249
00:09:12,710 --> 00:09:10,880
tugging each other so they don't happen

250
00:09:15,350 --> 00:09:12,720
as regularly as you would expect without

251
00:09:17,030 --> 00:09:15,360
the tug and with that measuring those

252
00:09:18,790 --> 00:09:17,040
differences what we're able to do is

253
00:09:20,870 --> 00:09:18,800
measure the masses of the planet so now

254
00:09:22,710 --> 00:09:20,880
we have the mass of the planet the size

255
00:09:24,230 --> 00:09:22,720
of the planet so we can make an estimate

256
00:09:25,590 --> 00:09:24,240
of what the density of the planet is and

257
00:09:26,710 --> 00:09:25,600
that's important because that gives us

258
00:09:28,230 --> 00:09:26,720
some understanding about what the

259
00:09:29,670 --> 00:09:28,240
composition of the planet is from that

260
00:09:31,670 --> 00:09:29,680
we can tell where the planets are

261
00:09:33,110 --> 00:09:31,680
whether they're rocky gaseous or even

262
00:09:34,389 --> 00:09:33,120
watery

263
00:09:37,110 --> 00:09:34,399

thanks john

264
00:09:38,710 --> 00:09:37,120
so nicole what can you tell us about

265
00:09:39,750 --> 00:09:38,720
studying the atmospheres of these

266
00:09:43,990 --> 00:09:39,760
planets

267
00:09:45,509 --> 00:09:44,000
us a great deal about the formation and

268
00:09:46,949 --> 00:09:45,519
evolution of planets and also about all

269
00:09:48,389 --> 00:09:46,959
the physical processes that are

270
00:09:50,150 --> 00:09:48,399
occurring on the planet's surface and in

271
00:09:51,670 --> 00:09:50,160
the air especially those that might make

272
00:09:54,070 --> 00:09:51,680
the planet habitable or actually

273
00:09:56,389 --> 00:09:54,080
indicative of hosting life

274
00:09:58,710 --> 00:09:56,399
we can use space-based telescopes today

275
00:09:59,990 --> 00:09:58,720
to to study the atmospheres of planets

276
00:10:02,150 --> 00:10:00,000
using a technique called transmission

277
00:10:04,230 --> 00:10:02,160
spectroscopy which detects the

278
00:10:06,630 --> 00:10:04,240
fingerprints of different chemical

279
00:10:09,030 --> 00:10:06,640
species in a planet's air such as water

280
00:10:10,389 --> 00:10:09,040
or methane ozone or oxygen we're

281
00:10:12,630 --> 00:10:10,399
currently using the hubble space

282
00:10:14,470 --> 00:10:12,640
telescope to study the planets in the

283
00:10:16,550 --> 00:10:14,480
trappist-1 system to determine if they

284
00:10:18,550 --> 00:10:16,560
have hydrogen helium-dominated

285
00:10:21,350 --> 00:10:18,560
atmospheres it's actually great to find

286
00:10:23,590 --> 00:10:21,360
out if they don't that gives us another

287
00:10:25,750 --> 00:10:23,600
push forward and having these planets be

288
00:10:27,430 --> 00:10:25,760

in fact rocky and also the potential of

289
00:10:29,990 --> 00:10:27,440
those planets to support water on their

290
00:10:31,430 --> 00:10:30,000
surfaces just last year hubble actually

291
00:10:33,750 --> 00:10:31,440
probed the innermost planets of the

292
00:10:35,509 --> 00:10:33,760
travis one system trappist b and c and

293
00:10:37,509 --> 00:10:35,519
found that they didn't have uh hydrogen

294
00:10:39,110 --> 00:10:37,519
helium-dominated atmospheres so that's

295
00:10:40,630 --> 00:10:39,120
just one more step along the path to

296
00:10:41,670 --> 00:10:40,640
having these potentially habitable

297
00:10:43,350 --> 00:10:41,680
worlds

298
00:10:45,430 --> 00:10:43,360
so what do we know about the three

299
00:10:48,389 --> 00:10:45,440
worlds in the habitable zone

300
00:10:49,590 --> 00:10:48,399
sure so i'll use eyes on exoplanets here

301
00:10:52,230 --> 00:10:49,600
to give you a brief tour of the

302
00:10:54,310 --> 00:10:52,240
habitable zone of the trappist-1 system

303
00:10:55,910 --> 00:10:54,320
so if we zoom out to the system away

304
00:10:57,350 --> 00:10:55,920
from the host star you'll see all seven

305
00:10:59,509 --> 00:10:57,360
planets with the habitable zone

306
00:11:01,190 --> 00:10:59,519
indicated here in this blue region the

307
00:11:04,949 --> 00:11:01,200
innermost planet in the habitable zone

308
00:11:09,350 --> 00:11:07,350
so in this illustration uh you'll you'll

309
00:11:10,870 --> 00:11:09,360
see an artist's rendition of trappist 1e

310
00:11:13,190 --> 00:11:10,880
which is a really interesting planet for

311
00:11:16,710 --> 00:11:13,200
a number of reasons it's very close in

312
00:11:17,910 --> 00:11:16,720
size to earth as you can see here

313
00:11:20,470 --> 00:11:17,920

it also is

314
00:11:22,710 --> 00:11:20,480
receives about the same amount of

315
00:11:24,550 --> 00:11:22,720
light as earth does in our own solar

316
00:11:26,470 --> 00:11:24,560
system

317
00:11:28,150 --> 00:11:26,480
this means that in trappist-1 e you

318
00:11:29,509 --> 00:11:28,160
could have temperatures that are very

319
00:11:30,790 --> 00:11:29,519
very similar to the ones that we have

320
00:11:34,630 --> 00:11:30,800
here on earth

321
00:11:36,550 --> 00:11:34,640
the next planet out is trappist-1 f

322
00:11:37,590 --> 00:11:36,560
now this is a potentially water-rich

323
00:11:39,590 --> 00:11:37,600
world

324
00:11:40,630 --> 00:11:39,600
that is again about the same size as

325
00:11:43,269 --> 00:11:40,640
earth

326
00:11:44,630 --> 00:11:43,279
you see here in comparison

327
00:11:46,870 --> 00:11:44,640
now trappist

328
00:11:48,870 --> 00:11:46,880
trappist 1f

329
00:11:50,470 --> 00:11:48,880
has about a nine day orbit and during

330
00:11:52,069 --> 00:11:50,480
that time it receives about the same

331
00:11:53,750 --> 00:11:52,079
amount of sunlight as mars does in our

332
00:11:55,269 --> 00:11:53,760
own solar system

333
00:11:57,110 --> 00:11:55,279
and the final planet in the habitable

334
00:12:00,389 --> 00:11:57,120
zone of the trappist-1 system is

335
00:12:05,829 --> 00:12:03,269
now trappist-1g is the largest planet in

336
00:12:08,069 --> 00:12:05,839
the trappist-1 system

337
00:12:10,230 --> 00:12:08,079
it's about 13

338
00:12:15,190 --> 00:12:10,240

larger radius than that of earth as you

339
00:12:19,110 --> 00:12:16,790
and it receives about the same amount of

340
00:12:20,629 --> 00:12:19,120
starlight as somewhere in between mars

341
00:12:22,310 --> 00:12:20,639
and the asteroid belt in our own solar

342
00:12:24,069 --> 00:12:22,320
system

343
00:12:25,990 --> 00:12:24,079
so while we don't have the technology

344
00:12:28,949 --> 00:12:26,000
yet to really travel to any of these

345
00:12:30,069 --> 00:12:28,959
planets how long would it take to travel

346
00:12:31,990 --> 00:12:30,079
here

347
00:12:34,550 --> 00:12:32,000
well thankfully we can ask eyes on

348
00:12:36,230 --> 00:12:34,560
exoplanets and if we were able to travel

349
00:12:38,550 --> 00:12:36,240
at light speed we of course could arrive

350
00:12:39,910 --> 00:12:38,560
in 39 years

351
00:12:41,829 --> 00:12:39,920
something more like a jet plane would

352
00:12:45,350 --> 00:12:41,839
take far longer of course something more

353
00:12:47,590 --> 00:12:45,360
on the line of 44 million years wow

354
00:12:49,590 --> 00:12:47,600
well then um thank you so much nicole

355
00:12:52,389 --> 00:12:49,600
now sarah why

356
00:12:54,310 --> 00:12:52,399
why are these discoveries so exciting

357
00:12:56,069 --> 00:12:54,320
for the scientific community well with

358
00:12:57,990 --> 00:12:56,079
this discovery we've made a giant

359
00:12:59,990 --> 00:12:58,000
accelerated leap forward in the search

360
00:13:02,310 --> 00:13:00,000
for habitable worlds and life on other

361
00:13:04,550 --> 00:13:02,320
worlds potentially speaking because with

362
00:13:07,430 --> 00:13:04,560
not just one planet but several

363
00:13:09,030 --> 00:13:07,440

we have room that if we didn't have the

364
00:13:10,949 --> 00:13:09,040
habitable zone quite right or weren't

365
00:13:12,949 --> 00:13:10,959
sure quite what we're looking for we

366
00:13:14,629 --> 00:13:12,959
have many chances over

367
00:13:16,550 --> 00:13:14,639
you could say colloquially

368
00:13:19,430 --> 00:13:16,560
it's like in this planetary system

369
00:13:21,750 --> 00:13:19,440
goldilocks has many sisters

370
00:13:24,069 --> 00:13:21,760
now we don't know much about the planets

371
00:13:25,670 --> 00:13:24,079
we know as we heard earlier the masses

372
00:13:27,670 --> 00:13:25,680
and sizes and how much radiation is

373
00:13:30,230 --> 00:13:27,680
falling on them and their orbits so for

374
00:13:31,670 --> 00:13:30,240
now we just speculate and for that uh

375
00:13:33,269 --> 00:13:31,680
the trappist-1 system has really

376
00:13:35,509 --> 00:13:33,279
captured our imagination and we have a

377
00:13:37,670 --> 00:13:35,519
new travel poster for you that you can

378
00:13:39,350 --> 00:13:37,680
download from the nasa website and if

379
00:13:41,190 --> 00:13:39,360
you see here it's captured

380
00:13:43,670 --> 00:13:41,200
scientifically accurately

381
00:13:45,110 --> 00:13:43,680
the um you know how on one of the

382
00:13:46,150 --> 00:13:45,120
planets you could see all the other

383
00:13:47,509 --> 00:13:46,160
planets

384
00:13:49,590 --> 00:13:47,519
in the sky

385
00:13:51,350 --> 00:13:49,600
now historically in exoplanets in the

386
00:13:54,550 --> 00:13:51,360
kind of brief history of the last 20

387
00:13:57,110 --> 00:13:54,560
years when there's one there's more and

388
00:13:59,110 --> 00:13:57,120

so that's why i'm so excited to be here

389
00:14:01,829 --> 00:13:59,120
today to share it with you because with

390
00:14:03,750 --> 00:14:01,839
this amazing system we know that there

391
00:14:05,910 --> 00:14:03,760
must be many more potentially

392
00:14:08,389 --> 00:14:05,920
life-bearing worlds out there just

393
00:14:11,110 --> 00:14:08,399
waiting to be found

394
00:14:13,110 --> 00:14:11,120
thanks so what are astronomers doing to

395
00:14:14,230 --> 00:14:13,120
learn more about this system and others

396
00:14:15,590 --> 00:14:14,240
like it

397
00:14:17,269 --> 00:14:15,600
well first of all

398
00:14:19,189 --> 00:14:17,279
mikel and his team

399
00:14:21,509 --> 00:14:19,199
have started uh to put up more

400
00:14:23,350 --> 00:14:21,519
telescopes they call it speculoos

401
00:14:25,750 --> 00:14:23,360
and they're going to from the ground use

402
00:14:27,189 --> 00:14:25,760
telescopes to search one thousand of the

403
00:14:28,829 --> 00:14:27,199
nearest um

404
00:14:30,629 --> 00:14:28,839
ultra-cool dwarf

405
00:14:32,389 --> 00:14:30,639
stars um

406
00:14:33,670 --> 00:14:32,399
and actually i just have to back up a

407
00:14:35,430 --> 00:14:33,680
second about this trappist system

408
00:14:37,189 --> 00:14:35,440
because i forgot to mention that one of

409
00:14:39,990 --> 00:14:37,199
the reasons astronomers are so excited

410
00:14:42,829 --> 00:14:40,000
about it is it's a veritable laboratory

411
00:14:46,150 --> 00:14:42,839
for studying uh planets orbiting very

412
00:14:48,470 --> 00:14:46,160
cool very small very dim red stars that

413
00:14:50,550 --> 00:14:48,480

are so incredibly different from our sun

414
00:14:53,990 --> 00:14:50,560
in fact astronomers constantly go back

415
00:14:55,350 --> 00:14:54,000
and forth about all the excitement about

416
00:14:57,910 --> 00:14:55,360
these worlds because they're very easy

417
00:15:00,389 --> 00:14:57,920
to study other people have fears and

418
00:15:01,829 --> 00:15:00,399
concerns and so we actually get to test

419
00:15:03,750 --> 00:15:01,839
many people's

420
00:15:05,750 --> 00:15:03,760
theories about these worlds being

421
00:15:07,670 --> 00:15:05,760
tidally locked and radiation from the

422
00:15:10,230 --> 00:15:07,680
host star and things like that so

423
00:15:12,230 --> 00:15:10,240
hopefully we're counting on speculoos to

424
00:15:14,310 --> 00:15:12,240
find more of these systems and planets

425
00:15:15,829 --> 00:15:14,320
around these ultra-cool dwarfs

426
00:15:16,870 --> 00:15:15,839
these very common stars that we can

427
00:15:18,389 --> 00:15:16,880
study

428
00:15:20,310 --> 00:15:18,399
so in addition to

429
00:15:21,829 --> 00:15:20,320
the speculos

430
00:15:24,150 --> 00:15:21,839
in astronomy when someone makes a

431
00:15:26,470 --> 00:15:24,160
discovery like this we put almost any

432
00:15:27,110 --> 00:15:26,480
telescope that can follow up to follow

433
00:15:29,509 --> 00:15:27,120
up

434
00:15:31,269 --> 00:15:29,519
and so in that way we have we heard

435
00:15:34,389 --> 00:15:31,279
about hubble already from nicole but the

436
00:15:36,389 --> 00:15:34,399
hubble on kepler k2 spitzer and other

437
00:15:38,470 --> 00:15:36,399
telescopes are exploring the trappist

438
00:15:40,310 --> 00:15:38,480

system further i'd say that what the

439
00:15:42,150 --> 00:15:40,320
team is most excited about although this

440
00:15:44,310 --> 00:15:42,160
is still a bit in the future is the

441
00:15:46,949 --> 00:15:44,320
james webb space telescope which will

442
00:15:48,949 --> 00:15:46,959
launch later in 2018 because with this

443
00:15:51,110 --> 00:15:48,959
telescope and the reason the trappist

444
00:15:53,110 --> 00:15:51,120
planets are so significant is that they

445
00:15:55,189 --> 00:15:53,120
are accessible to observations with the

446
00:15:57,269 --> 00:15:55,199
james webb space telescope you can see

447
00:15:58,790 --> 00:15:57,279
an animation of it here so with the

448
00:16:01,189 --> 00:15:58,800
james webb we'll be able to study the

449
00:16:02,870 --> 00:16:01,199
atmospheres and we will try to assess

450
00:16:04,230 --> 00:16:02,880
the greenhouse gas content which will

451
00:16:06,230 --> 00:16:04,240
help us understand the surface

452
00:16:07,350 --> 00:16:06,240
temperature of the planets are they

453
00:16:09,430 --> 00:16:07,360
indeed

454
00:16:11,430 --> 00:16:09,440
the right temperature to support liquid

455
00:16:12,870 --> 00:16:11,440
water and life as we know it in fact

456
00:16:15,189 --> 00:16:12,880
we're even going to use the james webb

457
00:16:17,590 --> 00:16:15,199
to search for gases gases that don't

458
00:16:20,069 --> 00:16:17,600
belong that might be produced by life

459
00:16:22,389 --> 00:16:20,079
such as oxygen ozone methane and a whole

460
00:16:24,949 --> 00:16:22,399
host of other gases

461
00:16:26,470 --> 00:16:24,959
thanks sarah so before we go into q a

462
00:16:27,910 --> 00:16:26,480
thomas do you have any clothing sought

463
00:16:30,230 --> 00:16:27,920

for us

464
00:16:32,550 --> 00:16:30,240
you know for me this research and

465
00:16:34,790 --> 00:16:32,560
exoplanets is really

466
00:16:36,710 --> 00:16:34,800
in its gold rush phase you know it

467
00:16:38,629 --> 00:16:36,720
started something like 20 years ago and

468
00:16:41,110 --> 00:16:38,639
i just couldn't help but notice that the

469
00:16:43,110 --> 00:16:41,120
last co-author on your paper is the same

470
00:16:45,189 --> 00:16:43,120
co-author who was there at the

471
00:16:48,550 --> 00:16:45,199
announcement of the first exoplanet ever

472
00:16:51,590 --> 00:16:48,560
discovered and announced in 1995 and

473
00:16:53,829 --> 00:16:51,600
since then we found thousands of those a

474
00:16:55,350 --> 00:16:53,839
little bit under 5 000 the last time i

475
00:16:58,230 --> 00:16:55,360
checked dozens of them are in the

476
00:17:01,189 --> 00:16:58,240
habitable zone none until now have had

477
00:17:03,829 --> 00:17:01,199
that many planets in the habitable zone

478
00:17:05,909 --> 00:17:03,839
and it's only expanding this is going

479
00:17:07,909 --> 00:17:05,919
forward at the rapid pace not just

480
00:17:10,309 --> 00:17:07,919
because of the telescopes that are there

481
00:17:12,309 --> 00:17:10,319
now but the telescopes were launching

482
00:17:13,350 --> 00:17:12,319
soon and you talked about

483
00:17:15,590 --> 00:17:13,360
the james

484
00:17:17,669 --> 00:17:15,600
webb telescope but also tess of course

485
00:17:19,990 --> 00:17:17,679
that's going to be there and w first

486
00:17:22,150 --> 00:17:20,000
that's being planned right now again

487
00:17:24,150 --> 00:17:22,160
really opening our lens opening our

488
00:17:26,630 --> 00:17:24,160

viewpoints onto the universe and

489
00:17:29,990 --> 00:17:26,640
especially in many cases these

490
00:17:32,150 --> 00:17:30,000
exoplanets i do believe that many of the

491
00:17:35,110 --> 00:17:32,160
best telescopes that will give us the

492
00:17:37,430 --> 00:17:35,120
most information are yet to be invented

493
00:17:39,590 --> 00:17:37,440
there's many things we don't know many

494
00:17:41,830 --> 00:17:39,600
questions we have that we have that come

495
00:17:43,990 --> 00:17:41,840
up when we see these observations we

496
00:17:46,789 --> 00:17:44,000
look at all these animations

497
00:17:48,870 --> 00:17:46,799
very likely nature is way more beautiful

498
00:17:51,590 --> 00:17:48,880
way more amazing than what we've

499
00:17:53,590 --> 00:17:51,600
animated here it's always that way and

500
00:17:56,070 --> 00:17:53,600
so for us the question is how do we

501
00:17:57,590 --> 00:17:56,080
actually open up our lens and see these

502
00:17:59,830 --> 00:17:57,600
things how do we

503
00:18:01,830 --> 00:17:59,840
get so much data from that that the kind

504
00:18:05,029 --> 00:18:01,840
of questions that sarah asked are

505
00:18:07,990 --> 00:18:05,039
actually able to be answered and for me

506
00:18:10,630 --> 00:18:08,000
at the end it's all about that thought

507
00:18:13,990 --> 00:18:10,640
that i have so often when i go to bed at

508
00:18:16,150 --> 00:18:14,000
nine and really imagine how these other

509
00:18:17,990 --> 00:18:16,160
worlds really look like the fact that

510
00:18:19,990 --> 00:18:18,000
there are worlds out there

511
00:18:22,630 --> 00:18:20,000
just like the earth

512
00:18:26,230 --> 00:18:22,640
that have some commonalities with the

513
00:18:27,270 --> 00:18:26,240

earth and you could imagine these worlds

514
00:18:29,830 --> 00:18:27,280
it just

515
00:18:32,789 --> 00:18:29,840
only happening right now these questions

516
00:18:35,270 --> 00:18:32,799
about are we alone are being answered as

517
00:18:38,630 --> 00:18:35,280
we speak in this decade and the next

518
00:18:40,950 --> 00:18:38,640
decades so i'm really excited about this

519
00:18:43,110 --> 00:18:40,960
thanks thomas with that let's transition

520
00:18:45,350 --> 00:18:43,120
to q a we've got a ton of questions on

521
00:18:46,870 --> 00:18:45,360
social media so we'll go there first if

522
00:18:49,430 --> 00:18:46,880
you'd like to ask a question using

523
00:18:52,310 --> 00:18:49,440
social media please use the hashtag

524
00:18:54,070 --> 00:18:52,320
asknasa

525
00:18:55,750 --> 00:18:54,080
all right wonderful we've got lots of

526
00:18:58,870 --> 00:18:55,760
questions coming in this first one comes

527
00:19:01,029 --> 00:18:58,880
from twitter user jams who asks what is

528
00:19:02,549 --> 00:19:01,039
the total amount of possibly habitable

529
00:19:06,470 --> 00:19:02,559
planets we have found including these

530
00:19:10,310 --> 00:19:07,990
okay the total number of habitable

531
00:19:11,990 --> 00:19:10,320
planets believe it or not is unknown and

532
00:19:14,630 --> 00:19:12,000
it depends on who you ask and how you

533
00:19:17,110 --> 00:19:14,640
count them we would say that there are

534
00:19:19,110 --> 00:19:17,120
let's say a few dozen exoplanets that

535
00:19:21,190 --> 00:19:19,120
you might consider habitable but the

536
00:19:23,590 --> 00:19:21,200
bottom line is that many of them may be

537
00:19:25,029 --> 00:19:23,600
a bit too hot or a bit too big we really

538
00:19:26,950 --> 00:19:25,039

have to wait until we can see the

539
00:19:28,630 --> 00:19:26,960
atmospheres to know how hot or cold the

540
00:19:30,630 --> 00:19:28,640
planets really are and that's why the

541
00:19:32,549 --> 00:19:30,640
trappist planets are so relevant because

542
00:19:34,870 --> 00:19:32,559
they actually unlike a lot of the other

543
00:19:39,350 --> 00:19:34,880
habitable zone planets we can actually

544
00:19:43,990 --> 00:19:41,029
wonderful all right the next question

545
00:19:45,750 --> 00:19:44,000
here comes from scott who asks any

546
00:19:48,310 --> 00:19:45,760
confirmation of water on the planetary

547
00:19:51,909 --> 00:19:49,830
yeah i can handle that one there's uh

548
00:19:54,230 --> 00:19:51,919
has not been any confirmation of water

549
00:19:57,029 --> 00:19:54,240
on these planetary bodies um and it will

550
00:19:59,270 --> 00:19:57,039
take a lot of a lot of observations uh

551
00:20:01,029 --> 00:19:59,280
with hubble or in the future with webb

552
00:20:03,110 --> 00:20:01,039
to probe the atmospheres and see if we

553
00:20:04,549 --> 00:20:03,120
can detect water on these planets but i

554
00:20:08,870 --> 00:20:04,559
think it's fair to add that people are

555
00:20:12,230 --> 00:20:10,310
great this question comes from twitter

556
00:20:14,870 --> 00:20:12,240
user matthew who asks will this be one

557
00:20:16,950 --> 00:20:14,880
of the first observations for jwst and

558
00:20:20,390 --> 00:20:16,960
how much can we learn about trappist ef

559
00:20:22,150 --> 00:20:20,400
and g until that mission launches

560
00:20:23,909 --> 00:20:22,160
you should know that i can i can take

561
00:20:26,310 --> 00:20:23,919
that one too

562
00:20:27,590 --> 00:20:26,320
you know a lot of folks um since

563
00:20:31,029 --> 00:20:27,600

learning about the system have thought

564
00:20:32,950 --> 00:20:31,039
about uh observing it with jwst and i am

565
00:20:34,870 --> 00:20:32,960
fairly certain that cycleone will see

566
00:20:36,789 --> 00:20:34,880
some observations of almost all of the

567
00:20:38,789 --> 00:20:36,799
planets in the system

568
00:20:40,230 --> 00:20:38,799
and then i guess to add further even now

569
00:20:42,390 --> 00:20:40,240
we're continuing to take observations

570
00:20:43,909 --> 00:20:42,400
from the ground and spitzer to look at

571
00:20:45,270 --> 00:20:43,919
the transit timing variation so we're

572
00:20:47,510 --> 00:20:45,280
going to get better measurements of the

573
00:20:48,630 --> 00:20:47,520
masses of these planets as time goes by

574
00:20:51,270 --> 00:20:48,640
and the next year we have much better

575
00:20:53,270 --> 00:20:51,280
measurements than we have currently

576
00:20:55,110 --> 00:20:53,280
okay we're going to take one question on

577
00:20:56,549 --> 00:20:55,120
the phone line from jay bennett from

578
00:20:59,669 --> 00:20:56,559
popular mechanics and then we're going

579
00:21:02,390 --> 00:20:59,679
to go back to social media so jay

580
00:21:05,029 --> 00:21:02,400
hello everyone uh i was wondering if the

581
00:21:07,190 --> 00:21:05,039
fact that trappist-1 is a particularly

582
00:21:09,430 --> 00:21:07,200
cool red dwarf means that it's more

583
00:21:10,870 --> 00:21:09,440
likely to support planets that are

584
00:21:13,190 --> 00:21:10,880
potentially habitable because it doesn't

585
00:21:16,710 --> 00:21:13,200
have as much stellar activity solar

586
00:21:19,350 --> 00:21:16,720
flares eruptions these types of things

587
00:21:20,470 --> 00:21:19,360
i can take this one so ultra cool

588
00:21:22,950 --> 00:21:20,480

dwarves

589
00:21:24,789 --> 00:21:22,960
are known to be very active when they

590
00:21:27,190 --> 00:21:24,799
are young and this is the main concern

591
00:21:29,830 --> 00:21:27,200
about these potentially habitable

592
00:21:31,190 --> 00:21:29,840
planets that they they they could have

593
00:21:33,590 --> 00:21:31,200
been uh

594
00:21:35,430 --> 00:21:33,600
the atmosphere been eroded strongly by

595
00:21:38,710 --> 00:21:35,440
the star when it was young now it's

596
00:21:40,630 --> 00:21:38,720
quite it's a quite ultra cool dwarfs so

597
00:21:42,470 --> 00:21:40,640
it's not very active but

598
00:21:43,990 --> 00:21:42,480
maybe uh when it was young the

599
00:21:46,630 --> 00:21:44,000
conditions were quite different so it

600
00:21:49,190 --> 00:21:46,640
will be by observation that will we we

601
00:21:51,750 --> 00:21:49,200
will really figure out the parts of this

602
00:21:55,350 --> 00:21:51,760
uh planet and what happened during this

603
00:21:57,190 --> 00:21:55,360
uh very active and uh young phase

604
00:21:58,789 --> 00:21:57,200
i'll just add to that and rephrase what

605
00:22:00,630 --> 00:21:58,799
mikhail said to just say the great news

606
00:22:02,230 --> 00:22:00,640
is we can observe in the near future we

607
00:22:04,630 --> 00:22:02,240
no longer have to rely on what we think

608
00:22:06,070 --> 00:22:04,640
and speculation because nature usually

609
00:22:09,350 --> 00:22:06,080
is smarter than we are and if there's

610
00:22:13,110 --> 00:22:09,360
any way for a life to get a foothold we

611
00:22:16,470 --> 00:22:14,549
thank you um we're gonna go back to

612
00:22:17,669 --> 00:22:16,480
social media so jason

613
00:22:19,750 --> 00:22:17,679

all right this question comes from

614
00:22:26,070 --> 00:22:19,760
twitter user amara who asks have you

615
00:22:29,430 --> 00:22:27,830
a name

616
00:22:31,830 --> 00:22:29,440
just give them them name well they win

617
00:22:33,590 --> 00:22:31,840
like a popular name like oh well we have

618
00:22:35,750 --> 00:22:33,600
plenty of possibilities which are all

619
00:22:39,270 --> 00:22:35,760
related to belgian beers but we don't

620
00:22:41,909 --> 00:22:39,280
think they will become official so

621
00:22:44,149 --> 00:22:41,919
for now let's call them vcd and and so

622
00:22:45,990 --> 00:22:44,159
on admittedly we have no way to easily

623
00:22:47,750 --> 00:22:46,000
give official names to

624
00:22:49,350 --> 00:22:47,760
exoplanets in the same way that we do

625
00:22:52,789 --> 00:22:49,360
for asteroids but perhaps it's something

626
00:22:56,390 --> 00:22:54,070
great this next question comes from

627
00:22:58,070 --> 00:22:56,400
twitter user joffeen who asks does the

628
00:23:01,029 --> 00:22:58,080
earth-sized planets have any moons

629
00:23:04,630 --> 00:23:01,039
revolving around them uh and if no how

630
00:23:07,029 --> 00:23:04,640
can there be possible waves on water

631
00:23:09,190 --> 00:23:07,039
well in our data we have no indication

632
00:23:10,230 --> 00:23:09,200
of a moon

633
00:23:12,789 --> 00:23:10,240
and so

634
00:23:15,590 --> 00:23:12,799
furthermore if we look at uh

635
00:23:16,950 --> 00:23:15,600
our theory uh it would be uh quite

636
00:23:19,270 --> 00:23:16,960
unlikely to have a moon around the

637
00:23:21,270 --> 00:23:19,280
planet so close to its star so maybe if

638
00:23:23,270 --> 00:23:21,280

there are other planets still to found

639
00:23:24,950 --> 00:23:23,280
them maybe they will they could have a

640
00:23:27,990 --> 00:23:24,960
moon we'll see in the future there are

641
00:23:29,830 --> 00:23:28,000
still many news to come about the system

642
00:23:31,990 --> 00:23:29,840
but i'll add further the tidal forces

643
00:23:34,549 --> 00:23:32,000
between the planets are not negligible

644
00:23:36,870 --> 00:23:34,559
so there if there was water on these uh

645
00:23:38,390 --> 00:23:36,880
planets there would be tides as well

646
00:23:41,990 --> 00:23:38,400
because of the tidal forces between the

647
00:23:45,190 --> 00:23:43,190
next we're going to go to the phone

648
00:23:47,430 --> 00:23:45,200
lines we have keith cowan from nasa

649
00:23:49,350 --> 00:23:47,440
watch keith

650
00:23:51,669 --> 00:23:49,360
a question probably best for sarah

651
00:23:54,470 --> 00:23:51,679
seeger i'm looking at these planets i

652
00:23:56,310 --> 00:23:54,480
assume they're really close together

653
00:23:58,390 --> 00:23:56,320
uh it reminds me of the jovian and the

654
00:24:00,390 --> 00:23:58,400
saturnian systems where

655
00:24:02,630 --> 00:24:00,400
stuff is thrown from one world onto

656
00:24:04,549 --> 00:24:02,640
another and there's questions about why

657
00:24:05,909 --> 00:24:04,559
you know is should you consider these as

658
00:24:07,750 --> 00:24:05,919
an ecosystem

659
00:24:09,669 --> 00:24:07,760
i'm a biologist i'm looking at three

660
00:24:11,430 --> 00:24:09,679
potentially habitable worlds real close

661
00:24:13,510 --> 00:24:11,440
to each other

662
00:24:15,350 --> 00:24:13,520
should we be thinking that conceivably

663
00:24:17,510 --> 00:24:15,360

the biosphere around this very

664
00:24:20,070 --> 00:24:17,520
tight-knit group of planets might extend

665
00:24:22,710 --> 00:24:20,080
beyond just one planet if they're this

666
00:24:24,710 --> 00:24:22,720
close to each other that's a wonderful

667
00:24:26,630 --> 00:24:24,720
question and we haven't thought that far

668
00:24:28,149 --> 00:24:26,640
yet but i'm sure there's a student out

669
00:24:29,830 --> 00:24:28,159
there you know listening in who should

670
00:24:31,669 --> 00:24:29,840
take this problem on

671
00:24:33,269 --> 00:24:31,679
i'll just back up one step though and

672
00:24:35,190 --> 00:24:33,279
answer a slightly different question

673
00:24:36,789 --> 00:24:35,200
because if we want to think about an

674
00:24:38,870 --> 00:24:36,799
intelligent civilization elsewhere

675
00:24:40,230 --> 00:24:38,880
looking back at us they may be having a

676
00:24:42,070 --> 00:24:40,240
press conference saying hey there's

677
00:24:43,750 --> 00:24:42,080
three habitable planets there

678
00:24:45,110 --> 00:24:43,760
venus earth and mars may appear to be in

679
00:24:47,269 --> 00:24:45,120
the habitable zone no matter how we

680
00:24:48,149 --> 00:24:47,279
describe it so let's wait and see what's

681
00:24:49,510 --> 00:24:48,159
out there

682
00:24:51,909 --> 00:24:49,520
but great question and hopefully

683
00:24:53,510 --> 00:24:51,919
somebody will work on this

684
00:24:56,630 --> 00:24:53,520
next on the phone lines we have marcia

685
00:24:59,269 --> 00:24:56,640
dunn from associated press

686
00:25:01,029 --> 00:24:59,279
yes hello i was wondering

687
00:25:02,630 --> 00:25:01,039
how many years do you think it might

688
00:25:03,830 --> 00:25:02,640

take

689
00:25:08,149 --> 00:25:03,840
to

690
00:25:11,029 --> 00:25:08,159
atmospheres of these exoplanets and i

691
00:25:11,830 --> 00:25:11,039
have a follow-up question

692
00:25:13,510 --> 00:25:11,840
yeah

693
00:25:15,510 --> 00:25:13,520
so we could actually make a substantial

694
00:25:17,510 --> 00:25:15,520
amount of progress to the next you know

695
00:25:20,070 --> 00:25:17,520
after the launch of jwst the next sort

696
00:25:22,070 --> 00:25:20,080
of five years range so starting with

697
00:25:23,909 --> 00:25:22,080
hubble and then moving into jwst to

698
00:25:25,990 --> 00:25:23,919
continue the exploration of these these

699
00:25:28,549 --> 00:25:26,000
atmospheres we could see results you

700
00:25:30,630 --> 00:25:28,559
know in the early uh 2020s

701
00:25:32,549 --> 00:25:30,640
and and thank you and i i know these are

702
00:25:34,870 --> 00:25:32,559
this is the first time seven earth-sized

703
00:25:37,110 --> 00:25:34,880
planets have appeared around a star like

704
00:25:39,190 --> 00:25:37,120
this what what is the

705
00:25:41,430 --> 00:25:39,200
what is the closest runner-up to that

706
00:25:45,029 --> 00:25:41,440
how many how many earth-sized planets

707
00:25:47,269 --> 00:25:45,039
around a star that you've seen prior

708
00:25:53,029 --> 00:25:47,279
three

709
00:25:54,950 --> 00:25:53,039
no more formed by kepler

710
00:25:56,310 --> 00:25:54,960
and which star is that

711
00:25:57,990 --> 00:25:56,320
i don't remember there are so many

712
00:26:02,230 --> 00:25:58,000
kepler planets

713
00:26:06,390 --> 00:26:04,789

so uh let's go back to social media

714
00:26:08,950 --> 00:26:06,400
jason

715
00:26:10,789 --> 00:26:08,960
all right this question comes from miles

716
00:26:12,230 --> 00:26:10,799
o'brien here on twitter who asks what

717
00:26:13,990 --> 00:26:12,240
sort of instrument could be used to

718
00:26:20,390 --> 00:26:14,000
answer the question of whether these

719
00:26:25,510 --> 00:26:23,350
sure so webb has a suite of instruments

720
00:26:27,110 --> 00:26:25,520
that cover you know wavelengths from

721
00:26:28,870 --> 00:26:27,120
sort of the near infrared all the way

722
00:26:30,070 --> 00:26:28,880
through farther into the infrared

723
00:26:31,669 --> 00:26:30,080
spectrum

724
00:26:34,310 --> 00:26:31,679
but in particular has a lot of very

725
00:26:35,830 --> 00:26:34,320
powerful spectrographs aboard so this is

726
00:26:37,669 --> 00:26:35,840
going to allow us to do this transm

727
00:26:39,909 --> 00:26:37,679
transmission spectroscopy technique that

728
00:26:41,269 --> 00:26:39,919
i talked about earlier and it covers the

729
00:26:43,669 --> 00:26:41,279
right wavelength range where we can

730
00:26:46,630 --> 00:26:43,679
start to detect molecules like water

731
00:26:48,950 --> 00:26:46,640
methane ozone and oxygen so we can start

732
00:26:50,710 --> 00:26:48,960
to do a lot of what sarah had suggested

733
00:26:53,430 --> 00:26:50,720
in trying to determine habitability and

734
00:26:55,110 --> 00:26:53,440
also the potential of harming life

735
00:26:57,029 --> 00:26:55,120
and i just want to add one thing and to

736
00:26:58,549 --> 00:26:57,039
miles and everyone out there is we

737
00:27:00,390 --> 00:26:58,559
really try to emphasize we have the

738
00:27:03,350 --> 00:27:00,400

capability to find signs of life

739
00:27:05,110 --> 00:27:03,360
elsewhere but nature has to deliver and

740
00:27:07,350 --> 00:27:05,120
because it's also new to us these red

741
00:27:09,990 --> 00:27:07,360
dwarf stars we don't totally know what's

742
00:27:12,070 --> 00:27:10,000
out there so if nature has made life

743
00:27:13,909 --> 00:27:12,080
ubiquitous and there are lots of

744
00:27:15,510 --> 00:27:13,919
atmospheres without clouds

745
00:27:17,190 --> 00:27:15,520
substantial enough

746
00:27:18,950 --> 00:27:17,200
accumulation of gases we'll have no

747
00:27:21,190 --> 00:27:18,960
trouble finding it at all but if it's

748
00:27:22,549 --> 00:27:21,200
the opposite then it may be a while but

749
00:27:24,070 --> 00:27:22,559
i did want to add one more point that we

750
00:27:25,990 --> 00:27:24,080
hadn't covered yet that

751
00:27:28,230 --> 00:27:26,000
um we have the test mission upcoming we

752
00:27:29,990 --> 00:27:28,240
have other ground-based searches so trap

753
00:27:32,149 --> 00:27:30,000
is one we're just here is the first it's

754
00:27:34,230 --> 00:27:32,159
the most exciting one so far but we hope

755
00:27:36,070 --> 00:27:34,240
to have many more of these and lots of

756
00:27:40,310 --> 00:27:36,080
chances to find signs of life in the

757
00:27:44,149 --> 00:27:42,070
wonderful next question here comes from

758
00:27:46,710 --> 00:27:44,159
twitter user chris sims who asks is it

759
00:27:49,190 --> 00:27:46,720
possible to listen to this planet system

760
00:27:52,390 --> 00:27:49,200
using our seti style telescopes how do

761
00:27:54,470 --> 00:27:52,400
we learn as much as possible

762
00:27:56,470 --> 00:27:54,480
to my to my knowledge it was already

763
00:27:59,190 --> 00:27:56,480

listened to by city and

764
00:28:00,230 --> 00:27:59,200
they had no signal from a artificial

765
00:28:03,110 --> 00:28:00,240
signal

766
00:28:07,750 --> 00:28:03,120
detected so it's doable but there's

767
00:28:11,830 --> 00:28:09,669
great next question comes from uh

768
00:28:13,350 --> 00:28:11,840
twitter user sawyer who asks how far

769
00:28:14,789 --> 00:28:13,360
into the foreseeable future until we

770
00:28:17,830 --> 00:28:14,799
might be able to see a craft that can

771
00:28:19,269 --> 00:28:17,840
actually make the journey to trappist-1

772
00:28:21,430 --> 00:28:19,279
this is a really hard question just

773
00:28:24,549 --> 00:28:21,440
because it requires so many miracles on

774
00:28:26,789 --> 00:28:24,559
the way see when james webb was

775
00:28:28,549 --> 00:28:26,799
developed the way i think about james

776
00:28:30,470 --> 00:28:28,559
webb it required something like 10

777
00:28:31,430 --> 00:28:30,480
miracles kind of things we had never

778
00:28:33,350 --> 00:28:31,440
done

779
00:28:35,350 --> 00:28:33,360
and and kind of put it together into a

780
00:28:38,070 --> 00:28:35,360
telescope you know with a six and a half

781
00:28:40,070 --> 00:28:38,080
meter kind of foldable mirror and a

782
00:28:41,909 --> 00:28:40,080
thermal system that's a tennis court in

783
00:28:43,669 --> 00:28:41,919
size you know kind of how do you do that

784
00:28:45,190 --> 00:28:43,679
the answer is you start inventing your

785
00:28:48,149 --> 00:28:45,200
way forward

786
00:28:51,350 --> 00:28:48,159
this a question that's being asked

787
00:28:53,029 --> 00:28:51,360
may be a 100 miracle type of question

788
00:28:55,190 --> 00:28:53,039

and some of them probably relate to

789
00:28:56,950 --> 00:28:55,200
nuclear propulsion some of them some of

790
00:28:59,029 --> 00:28:56,960
these miracles relate to radiation

791
00:29:00,950 --> 00:28:59,039
protection they relate to things that

792
00:29:02,950 --> 00:29:00,960
we're just starting to push at now the

793
00:29:04,950 --> 00:29:02,960
good news is there's a lot of work

794
00:29:07,510 --> 00:29:04,960
that's being done on kind of the first

795
00:29:09,830 --> 00:29:07,520
five to ten of those miracles that that

796
00:29:12,310 --> 00:29:09,840
are being looked at not necessarily

797
00:29:14,389 --> 00:29:12,320
because we have our eyes set right now

798
00:29:17,029 --> 00:29:14,399
i'm going to start it's a big leap but

799
00:29:19,110 --> 00:29:17,039
because we're looking for example at the

800
00:29:21,430 --> 00:29:19,120
outer solar system we want to get there

801
00:29:23,190 --> 00:29:21,440
a lot faster we want to get there with

802
00:29:26,549 --> 00:29:23,200
more payload we want to get there with

803
00:29:28,310 --> 00:29:26,559
more energy and so so the way this game

804
00:29:31,510 --> 00:29:28,320
works it's really

805
00:29:33,830 --> 00:29:31,520
the it's leaning forward it's really

806
00:29:35,990 --> 00:29:33,840
just because it takes 100 miracles not

807
00:29:38,070 --> 00:29:36,000
backing up that's really what i would

808
00:29:40,310 --> 00:29:38,080
believe is what nasa is all about and

809
00:29:42,389 --> 00:29:40,320
that's also what led to this kind of

810
00:29:45,029 --> 00:29:42,399
discovery in many ways you know spitzer

811
00:29:47,830 --> 00:29:45,039
itself had a whole bunch of miracles on

812
00:29:49,830 --> 00:29:47,840
detectors and and systems and the same

813
00:29:52,630 --> 00:29:49,840

is true for the other question i'd like

814
00:29:53,750 --> 00:29:52,640
to just very briefly mention our

815
00:29:55,110 --> 00:29:53,760
colleagues at the breakthrough

816
00:29:57,350 --> 00:29:55,120
foundation and the project called

817
00:30:00,630 --> 00:29:57,360
starshot and you can go look that up and

818
00:30:02,789 --> 00:30:00,640
see that they're planning uh 19 miracles

819
00:30:04,950 --> 00:30:02,799
to figure out a way to send very tiny

820
00:30:06,870 --> 00:30:04,960
and thousands of little tiny spacecraft

821
00:30:08,870 --> 00:30:06,880
flying by the very nearest stars that

822
00:30:10,789 --> 00:30:08,880
would be proxima centauri not quite like

823
00:30:12,070 --> 00:30:10,799
trappist but i just want to remind all

824
00:30:13,590 --> 00:30:12,080
of you although it may sound

825
00:30:15,750 --> 00:30:13,600
discouraging perhaps that in our

826
00:30:18,149 --> 00:30:15,760
lifetime we won't have a way to see how

827
00:30:19,990 --> 00:30:18,159
to get to trappist-1 that we're here

828
00:30:22,870 --> 00:30:20,000
because we have these big sophisticated

829
00:30:24,950 --> 00:30:22,880
space telescopes um hubble spitzer james

830
00:30:26,870 --> 00:30:24,960
webb and future ones and we're big on

831
00:30:28,549 --> 00:30:26,880
remote sensing so even though we have

832
00:30:29,990 --> 00:30:28,559
that's what we have to live for

833
00:30:31,750 --> 00:30:30,000
we are still very excited about the

834
00:30:33,029 --> 00:30:31,760
possibility of using our telescopes to

835
00:30:35,190 --> 00:30:33,039
see what's there

836
00:30:39,510 --> 00:30:35,200
rather than we have to leave

837
00:30:41,269 --> 00:30:39,520
the trip there to future generations

838
00:30:42,710 --> 00:30:41,279

we've got a lot of questions on social

839
00:30:44,950 --> 00:30:42,720
media so we're just going to keep them

840
00:30:46,710 --> 00:30:44,960
coming jason what other questions do are

841
00:30:49,110 --> 00:30:46,720
we getting sure this next question comes

842
00:30:51,110 --> 00:30:49,120
from twitter user aku who asks any

843
00:30:53,190 --> 00:30:51,120
estimations on how old these discovered

844
00:30:55,590 --> 00:30:53,200
exoplanets are

845
00:30:57,590 --> 00:30:55,600
yes the age of the star and the system

846
00:30:59,350 --> 00:30:57,600
itself is fully constrained

847
00:31:02,149 --> 00:30:59,360
we know it's not very young it doesn't

848
00:31:02,830 --> 00:31:02,159
show signs of youngness so it's

849
00:31:03,990 --> 00:31:02,840
at

850
00:31:06,630 --> 00:31:04,000
least uh

851
00:31:09,110 --> 00:31:06,640
half a billion years old but we can't

852
00:31:11,909 --> 00:31:09,120
say more because these ultrakurdwa stars

853
00:31:12,710 --> 00:31:11,919
they evolve super slowly their lifetime

854
00:31:15,590 --> 00:31:12,720
is

855
00:31:18,230 --> 00:31:15,600
1000 times larger than for a sun-like

856
00:31:21,909 --> 00:31:18,240
stars so we don't see them evolving so

857
00:31:25,350 --> 00:31:23,190
all right this next question comes from

858
00:31:26,950 --> 00:31:25,360
facebook live here what is the distance

859
00:31:29,350 --> 00:31:26,960
between these three planets is it

860
00:31:31,190 --> 00:31:29,360
something like 500 000 kilometers and

861
00:31:32,950 --> 00:31:31,200
what is the distance between e and the

862
00:31:33,909 --> 00:31:32,960
star

863
00:31:36,470 --> 00:31:33,919

oh

864
00:31:38,470 --> 00:31:36,480
the distance uh between the planets are

865
00:31:40,389 --> 00:31:38,480
a few times the distance between the

866
00:31:41,590 --> 00:31:40,399
earth and the moon so we're talking

867
00:31:44,389 --> 00:31:41,600
about uh

868
00:31:46,389 --> 00:31:44,399
something like a thousand well millions

869
00:31:48,950 --> 00:31:46,399
of kilometers and not

870
00:31:51,350 --> 00:31:48,960
hundreds of millions of kilometers for a

871
00:31:55,269 --> 00:31:51,360
nerf around the sun like star

872
00:31:57,990 --> 00:31:55,279
and for the planet uh f uh the e so the

873
00:32:00,149 --> 00:31:58,000
distance is something like five percent

874
00:32:01,190 --> 00:32:00,159
the distance between the earth and and

875
00:32:03,110 --> 00:32:01,200
the sun

876
00:32:07,190 --> 00:32:03,120
so it's much much

877
00:32:10,789 --> 00:32:08,310
great this next question comes from

878
00:32:13,190 --> 00:32:10,799
twitter user ross butler who asks is the

879
00:32:17,190 --> 00:32:13,200
trappist-1 system the closest to us with

880
00:32:20,789 --> 00:32:17,990
no

881
00:32:23,190 --> 00:32:20,799
in fact the closest is proxima century

882
00:32:25,590 --> 00:32:23,200
which has a planet which was detected by

883
00:32:27,590 --> 00:32:25,600
radial velocity so by another method

884
00:32:28,389 --> 00:32:27,600
which doesn't tell us the size knows the

885
00:32:30,149 --> 00:32:28,399
mass

886
00:32:34,389 --> 00:32:30,159
so we don't know if it's a rocky planet

887
00:32:39,509 --> 00:32:37,269
it's only at four light years away

888
00:32:40,870 --> 00:32:39,519

it's a closer star in fact all right

889
00:32:42,789 --> 00:32:40,880
wonderful this next question comes from

890
00:32:45,269 --> 00:32:42,799
twitter user unconventional tiger who

891
00:32:47,269 --> 00:32:45,279
asks uh i would like to know the range

892
00:32:49,430 --> 00:32:47,279
of orbital periods for the seven rocky

893
00:32:52,389 --> 00:32:49,440
planets in the trappist system

894
00:32:54,310 --> 00:32:52,399
so the range goes from 1.5 days for the

895
00:32:56,310 --> 00:32:54,320
innermost planet to

896
00:32:58,389 --> 00:32:56,320
we don't know the period of the outer

897
00:32:59,350 --> 00:32:58,399
planet but it must be something like 20

898
00:33:02,950 --> 00:32:59,360
days

899
00:33:04,630 --> 00:33:02,960
so super short period compared to uh the

900
00:33:06,789 --> 00:33:04,640
earth i think oh do you want to add the

901
00:33:07,830 --> 00:33:06,799
ratios uh you can have the ratio yeah i

902
00:33:10,789 --> 00:33:07,840
think miguel i think you should have the

903
00:33:11,909 --> 00:33:10,799
resonance in the integer ratios ah okay

904
00:33:18,950 --> 00:33:11,919
so

905
00:33:20,149 --> 00:33:18,960
are related by ratios of integer numbers

906
00:33:22,389 --> 00:33:20,159
which is very

907
00:33:24,149 --> 00:33:22,399
peculiar dynamical configuration that we

908
00:33:25,750 --> 00:33:24,159
can find in our solar system for the

909
00:33:28,789 --> 00:33:25,760
galilean moon

910
00:33:30,549 --> 00:33:28,799
around jupiter and it shows that it

911
00:33:32,630 --> 00:33:30,559
indicates at least that this planet

912
00:33:34,789 --> 00:33:32,640
should have formed further heart and

913
00:33:37,830 --> 00:33:34,799

migrated and been trapped during this

914
00:33:40,230 --> 00:33:37,840
migration inwards in this very peculiar

915
00:33:41,830 --> 00:33:40,240
uh configuration if this is the case

916
00:33:44,149 --> 00:33:41,840
they are super water rich because they

917
00:33:46,950 --> 00:33:44,159
must have form in an environment which

918
00:33:49,029 --> 00:33:46,960
was very rich in ice uh or in water

919
00:33:50,870 --> 00:33:49,039
highs and they it should be reflected in

920
00:33:53,350 --> 00:33:50,880
their composition and we will know soon

921
00:33:55,269 --> 00:33:53,360
thanks to notably to many new spitzer

922
00:33:57,110 --> 00:33:55,279
observations that are coming

923
00:33:58,870 --> 00:33:57,120
okay before we take more questions from

924
00:34:01,350 --> 00:33:58,880
social media i'd like to ask each of you

925
00:34:03,110 --> 00:34:01,360
to kind of give some thoughts about why

926
00:34:04,549 --> 00:34:03,120
this finding is so exciting for you

927
00:34:07,269 --> 00:34:04,559
personally and we're going to start with

928
00:34:09,270 --> 00:34:07,279
nicole and then work our way to thomas

929
00:34:11,510 --> 00:34:09,280
yeah so this side this finding is really

930
00:34:13,349 --> 00:34:11,520
exciting for me because this is a great

931
00:34:15,829 --> 00:34:13,359
opportunity to study

932
00:34:18,710 --> 00:34:15,839
earth-sized planets atmospheres in great

933
00:34:20,389 --> 00:34:18,720
detail we know that we have good you can

934
00:34:22,310 --> 00:34:20,399
get good signal-to-noise ratios and we

935
00:34:24,790 --> 00:34:22,320
can start to begin this journey in

936
00:34:25,990 --> 00:34:24,800
trying to understand what the air is

937
00:34:27,669 --> 00:34:26,000
like around

938
00:34:29,190 --> 00:34:27,679

rocky planets outside of our solar

939
00:34:31,030 --> 00:34:29,200
system

940
00:34:32,389 --> 00:34:31,040
well i'll give two favorite reasons one

941
00:34:35,190 --> 00:34:32,399
is when i and others started in

942
00:34:37,270 --> 00:34:35,200
exoplanets 20 years ago our peers all

943
00:34:38,470 --> 00:34:37,280
dismissed the work as just stamp

944
00:34:39,669 --> 00:34:38,480
collecting we'd never look at their

945
00:34:41,270 --> 00:34:39,679
atmospheres we never be able to do this

946
00:34:43,349 --> 00:34:41,280
we never just do that so the fact that

947
00:34:44,869 --> 00:34:43,359
we're here today with seven planets and

948
00:34:46,950 --> 00:34:44,879
we know we can study their atmospheres

949
00:34:48,389 --> 00:34:46,960
in the future is truly tremendous

950
00:34:49,990 --> 00:34:48,399
the other point i want to make is that

951
00:34:53,030 --> 00:34:50,000
we see we're really excited because we

952
00:34:54,950 --> 00:34:53,040
all see ourselves here as just we're the

953
00:34:57,270 --> 00:34:54,960
group of people we meaning us and all of

954
00:34:58,550 --> 00:34:57,280
our colleagues as the pioneers this is a

955
00:35:00,390 --> 00:34:58,560
search that will go on for many

956
00:35:02,550 --> 00:35:00,400
generations and just the fact that we're

957
00:35:05,670 --> 00:35:02,560
this close now to finding so many

958
00:35:07,510 --> 00:35:05,680
habitable worlds is really exciting

959
00:35:09,030 --> 00:35:07,520
yeah so so for me it's more of a very

960
00:35:11,589 --> 00:35:09,040
kind of a personal experience because

961
00:35:13,750 --> 00:35:11,599
i've been worked on spitzer since 2002

962
00:35:15,270 --> 00:35:13,760
and the ability to be able to do these

963
00:35:17,430 --> 00:35:15,280

observations we had to do a fair amount

964
00:35:19,109 --> 00:35:17,440
of engineering work and at the beginning

965
00:35:21,109 --> 00:35:19,119
it wasn't clear necessarily that we

966
00:35:23,030 --> 00:35:21,119
would be able to achieve

967
00:35:25,190 --> 00:35:23,040
the precisions we need to do up science

968
00:35:27,589 --> 00:35:25,200
like this so it's very gratifying that

969
00:35:29,430 --> 00:35:27,599
all our hard work myself my colleagues

970
00:35:31,670 --> 00:35:29,440
at the spitzer science center jpl and

971
00:35:32,950 --> 00:35:31,680
lockheed martin the engineers there

972
00:35:34,790 --> 00:35:32,960
you know we're able to pull it off and

973
00:35:37,270 --> 00:35:34,800
we're able to be able to give great data

974
00:35:39,589 --> 00:35:37,280
to scientists and get great results out

975
00:35:41,510 --> 00:35:39,599
so it's it's uh i'm very happy about

976
00:35:44,470 --> 00:35:41,520
this

977
00:35:46,069 --> 00:35:44,480
so on my side i've already been uh

978
00:35:48,069 --> 00:35:46,079
i've already wondered about the possible

979
00:35:48,870 --> 00:35:48,079
existence of life elsewhere since i'm a

980
00:35:53,109 --> 00:35:48,880
kid

981
00:35:55,670 --> 00:35:53,119
and so when i uh went to college to

982
00:35:57,190 --> 00:35:55,680
study science i first studied biology

983
00:35:58,870 --> 00:35:57,200
biochemistry because i wanted to

984
00:36:00,950 --> 00:35:58,880
understand what is life really and i

985
00:36:03,270 --> 00:36:00,960
switched to astronomy because it was the

986
00:36:05,430 --> 00:36:03,280
beginning of the exoplanet adventure we

987
00:36:07,349 --> 00:36:05,440
were really beginning to detect planets

988
00:36:08,950 --> 00:36:07,359

outside the solar system and it was

989
00:36:11,430 --> 00:36:08,960
clear that within a few decades we would

990
00:36:13,829 --> 00:36:11,440
be not detecting giant planets which

991
00:36:15,670 --> 00:36:13,839
were unsuitable for life but planets

992
00:36:18,069 --> 00:36:15,680
that uh that could host life that we

993
00:36:21,270 --> 00:36:18,079
could study so i've already been

994
00:36:23,670 --> 00:36:21,280
devoting my time in science to this goal

995
00:36:25,510 --> 00:36:23,680
and uh then we are we're getting nearly

996
00:36:26,630 --> 00:36:25,520
there with this result it's it's a very

997
00:36:29,190 --> 00:36:26,640
good uh

998
00:36:32,069 --> 00:36:29,200
satisfaction for me

999
00:36:34,950 --> 00:36:32,079
to me looking from the point of view of

1000
00:36:36,310 --> 00:36:34,960
uh nasa science program it's exciting

1001
00:36:38,310 --> 00:36:36,320
because it's of course it's a leap

1002
00:36:40,550 --> 00:36:38,320
forward but it goes in parallel to the

1003
00:36:42,470 --> 00:36:40,560
other leaps we're taking right now look

1004
00:36:44,950 --> 00:36:42,480
at what's happening at mars where we're

1005
00:36:46,630 --> 00:36:44,960
really looking at the complex chemistry

1006
00:36:48,310 --> 00:36:46,640
that's happening there look at the

1007
00:36:49,990 --> 00:36:48,320
recognition that mars actually is a

1008
00:36:52,790 --> 00:36:50,000
place where they're not only used to be

1009
00:36:55,430 --> 00:36:52,800
water but there's water today abundant

1010
00:36:56,230 --> 00:36:55,440
water uh in parallel to that uh you know

1011
00:37:00,150 --> 00:36:56,240
the

1012
00:37:02,230 --> 00:37:00,160
technology ability of going to europa

1013
00:37:05,109 --> 00:37:02,240

and actually looking at that system

1014
00:37:07,349 --> 00:37:05,119
which is in its own right really an

1015
00:37:09,589 --> 00:37:07,359
exciting system because there's an ocean

1016
00:37:12,470 --> 00:37:09,599
world there that hits the rock at the

1017
00:37:15,510 --> 00:37:12,480
bottom in a really unexpected place in a

1018
00:37:17,910 --> 00:37:15,520
site there's many other places like that

1019
00:37:19,990 --> 00:37:17,920
and then the on the theory side we

1020
00:37:22,550 --> 00:37:20,000
already heard that kind of

1021
00:37:23,990 --> 00:37:22,560
really understanding of the biology of

1022
00:37:26,630 --> 00:37:24,000
lives kind of there's a tremendous

1023
00:37:28,950 --> 00:37:26,640
amount of progress so together these

1024
00:37:31,349 --> 00:37:28,960
areas really create kind of a crescendo

1025
00:37:33,109 --> 00:37:31,359
towards that uh really answering that

1026
00:37:34,710 --> 00:37:33,119
question that has been on our minds for

1027
00:37:36,710 --> 00:37:34,720
so long this is

1028
00:37:38,069 --> 00:37:36,720
the the right time to ask that question

1029
00:37:39,910 --> 00:37:38,079
and it's the right time to have this

1030
00:37:40,870 --> 00:37:39,920
discovery right now

1031
00:37:42,310 --> 00:37:40,880
thank you

1032
00:37:43,270 --> 00:37:42,320
i'm afraid that's all the time we have

1033
00:37:45,349 --> 00:37:43,280
left

1034
00:37:47,589 --> 00:37:45,359
please keep those questions coming by

1035
00:37:48,470 --> 00:37:47,599
sending them at the

1036
00:37:49,829 --> 00:37:48,480
sorry

1037
00:37:52,630 --> 00:37:49,839
ask

1038
00:37:55,430 --> 00:37:52,640

and for more information and to download

1039
00:37:58,670 --> 00:37:55,440
the eyes on exoplanets app that nicole

1040
00:38:00,390 --> 00:37:58,680
was just using earlier please go to

1041
00:38:02,069 --> 00:38:00,400
nasa.gov

1042
00:38:03,990 --> 00:38:02,079
exoplanets