
NASA
SCIENCE LIVE
VIRTUAL EDITION
WHAT'S NEXT FOR
WEBB

1
00:00:00,250 --> 00:00:22,390
[Music]

2
00:00:22,400 --> 00:00:27,010
so

3
00:00:42,630 --> 00:00:32,760
[Music]

4
00:00:47,990 --> 00:00:45,190
hello and welcome to a very special

5
00:00:51,110 --> 00:00:48,000
episode of nasa science live i'm your

6
00:00:53,110 --> 00:00:51,120
host tahira allen and today i am so

7
00:00:55,910 --> 00:00:53,120
thrilled to be talking to you about

8
00:00:58,790 --> 00:00:55,920
another key milestone in the james webb

9
00:00:59,990 --> 00:00:58,800
space telescope's journey to unfold the

10
00:01:03,110 --> 00:01:00,000
universe

11
00:01:05,509 --> 00:01:03,120
the past month has been so exciting for

12
00:01:08,070 --> 00:01:05,519
webb from the breathtaking launch in

13
00:01:10,950 --> 00:01:08,080

french guyana on christmas day to the

14
00:01:12,550 --> 00:01:10,960
two-week unfolding of this intricately

15
00:01:15,429 --> 00:01:12,560
packed telescope

16
00:01:18,070 --> 00:01:15,439
and now the excitement continues

17
00:01:21,190 --> 00:01:18,080
not only did everything deploy properly

18
00:01:23,749 --> 00:01:21,200
just as expected but moments ago the

19
00:01:26,550 --> 00:01:23,759
james webb space telescope completed its

20
00:01:28,469 --> 00:01:26,560
final burn and has now arrived at its

21
00:01:30,390 --> 00:01:28,479
final destination

22
00:01:32,870 --> 00:01:30,400
today we are going to be talking about

23
00:01:35,510 --> 00:01:32,880
what's next for webb as it embarks on

24
00:01:38,069 --> 00:01:35,520
its mission to uncover more about our

25
00:01:40,630 --> 00:01:38,079
universe and our place in it

26
00:01:43,030 --> 00:01:40,640
we have a lot of viewers who are very

27
00:01:45,830 --> 00:01:43,040
interested and just excited about this

28
00:01:46,870 --> 00:01:45,840
mission and today we want to hear from

29
00:01:49,030 --> 00:01:46,880
you

30
00:01:51,270 --> 00:01:49,040
for those watching live feel free to

31
00:01:53,749 --> 00:01:51,280
participate in today's show by

32
00:01:56,870 --> 00:01:53,759
submitting a question on social media

33
00:01:59,109 --> 00:01:56,880
using the hashtag unfold the universe

34
00:02:00,789 --> 00:01:59,119
you can also drop a question directly

35
00:02:02,870 --> 00:02:00,799
into the comment box wherever you're

36
00:02:05,030 --> 00:02:02,880
watching the stream from we will be

37
00:02:06,950 --> 00:02:05,040
getting to those questions live on air

38
00:02:09,589 --> 00:02:06,960

so stay tuned

39
00:02:12,070 --> 00:02:09,599
joining me today are two very special

40
00:02:14,949 --> 00:02:12,080
people who are here to answer all of

41
00:02:17,430 --> 00:02:14,959
your burning questions we have dr amber

42
00:02:19,750 --> 00:02:17,440
strohn who is the web deputy project

43
00:02:23,110 --> 00:02:19,760
scientist for communications at nasa

44
00:02:25,990 --> 00:02:23,120
goddard and scarlet hernandez who is the

45
00:02:29,110 --> 00:02:26,000
web flight systems engineer at the space

46
00:02:31,670 --> 00:02:29,120
telescope science institute ladies thank

47
00:02:33,670 --> 00:02:31,680
you so much for being here today we are

48
00:02:35,430 --> 00:02:33,680
so happy to have you

49
00:02:37,190 --> 00:02:35,440
thank you for inviting me i'm very happy

50
00:02:39,589 --> 00:02:37,200
to be here

51
00:02:41,750 --> 00:02:39,599
yeah thank you very exciting day good

52
00:02:44,550 --> 00:02:41,760
good to be here

53
00:02:46,790 --> 00:02:44,560
yeah i mean absolutely so i can only

54
00:02:48,869 --> 00:02:46,800
imagine that you two are on the edge of

55
00:02:52,710 --> 00:02:48,879
your seat with web having finally

56
00:02:55,190 --> 00:02:52,720
arrived at its new home in space scarlet

57
00:02:57,910 --> 00:02:55,200
can you walk us through a little bit of

58
00:03:00,630 --> 00:02:57,920
about what had to happen today to ensure

59
00:03:02,550 --> 00:03:00,640
that webb arrived safe and sound in its

60
00:03:04,949 --> 00:03:02,560
new orbit

61
00:03:07,990 --> 00:03:04,959
absolutely so um as i was saying i'm

62
00:03:10,550 --> 00:03:08,000
super excited um we're fully deployed

63
00:03:12,229 --> 00:03:10,560

and just about an hour ago uh we

64
00:03:14,630 --> 00:03:12,239
performed our final mid-course

65
00:03:16,630 --> 00:03:14,640
correction uh which was about five

66
00:03:19,110 --> 00:03:16,640
minutes in duration

67
00:03:21,750 --> 00:03:19,120
um and here actually you can see a live

68
00:03:23,990 --> 00:03:21,760
feed of the mission control center this

69
00:03:26,309 --> 00:03:24,000
is actually the launch and commissioning

70
00:03:29,030 --> 00:03:26,319
support room where all of the spacecraft

71
00:03:31,589 --> 00:03:29,040
engineers and subject matter experts

72
00:03:34,309 --> 00:03:31,599
are located and i can see here on the

73
00:03:35,670 --> 00:03:34,319
bottom right there's a perry he's the

74
00:03:38,149 --> 00:03:35,680
lead of uh

75
00:03:41,190 --> 00:03:38,159
from our thermal team i see flight

76
00:03:44,550 --> 00:03:41,200
software right behind there

77
00:03:46,309 --> 00:03:44,560
and i see uh some from our power team

78
00:03:47,990 --> 00:03:46,319
our communications team so it's all

79
00:03:50,470 --> 00:03:48,000
hands on deck here

80
00:03:53,270 --> 00:03:50,480
of course we have the delta v team our

81
00:03:56,229 --> 00:03:53,280
change in velocity uh team that helped

82
00:03:59,030 --> 00:03:56,239
us get into our l2 orbit today

83
00:04:01,910 --> 00:03:59,040
so as i was saying super excited

84
00:04:04,710 --> 00:04:01,920
we of course had a series of steps

85
00:04:06,309 --> 00:04:04,720
um to take to ensure safety uh like

86
00:04:07,350 --> 00:04:06,319
making sure that our storage system

87
00:04:10,149 --> 00:04:07,360
momentum

88
00:04:12,630 --> 00:04:10,159

was below the expected threshold uh we

89
00:04:15,030 --> 00:04:12,640
had to uplink our ephemeris which is

90
00:04:17,430 --> 00:04:15,040
basically a table of our expected

91
00:04:19,270 --> 00:04:17,440
positions on each axis

92
00:04:21,189 --> 00:04:19,280
over a period of time

93
00:04:23,670 --> 00:04:21,199
and we work very closely with the flight

94
00:04:25,189 --> 00:04:23,680
dynamics team for the positioning data

95
00:04:27,430 --> 00:04:25,199
and these burns

96
00:04:29,270 --> 00:04:27,440
we also had to activate specific heater

97
00:04:30,950 --> 00:04:29,280
groups to ensure that we were warm

98
00:04:32,469 --> 00:04:30,960
enough to start

99
00:04:34,710 --> 00:04:32,479
and then we were able to beautifully

100
00:04:36,310 --> 00:04:34,720
execute the burn which like i said was

101
00:04:38,790 --> 00:04:36,320
about five minutes

102
00:04:41,110 --> 00:04:38,800
and so we're now at our orbital

103
00:04:44,710 --> 00:04:41,120
destination and soon enough be able to

104
00:04:48,230 --> 00:04:46,790
wow thank you for walking us through

105
00:04:50,790 --> 00:04:48,240
that it sounds like

106
00:04:53,270 --> 00:04:50,800
a lot had to happen today and

107
00:04:56,230 --> 00:04:53,280
that's basically how this past month has

108
00:04:58,550 --> 00:04:56,240
gone for webb so much had to go right to

109
00:05:01,590 --> 00:04:58,560
get us to even this moment that we're

110
00:05:03,990 --> 00:05:01,600
here at right now and so amber could you

111
00:05:06,550 --> 00:05:04,000
briefly describe the past 30 days for

112
00:05:09,029 --> 00:05:06,560
webb and help us understand what all had

113
00:05:10,870 --> 00:05:09,039

to go perfectly to get webb to where it

114
00:05:13,670 --> 00:05:10,880
is right now

115
00:05:16,029 --> 00:05:13,680
yeah wow what a ride this last month has

116
00:05:19,270 --> 00:05:16,039
been i mean it started with this

117
00:05:21,430 --> 00:05:19,280
spectacular launch on christmas morning

118
00:05:23,430 --> 00:05:21,440
um what a what a beautiful beautiful

119
00:05:27,189 --> 00:05:23,440
thing to happen and you know the launch

120
00:05:29,590 --> 00:05:27,199
itself was super efficient just almost

121
00:05:31,990 --> 00:05:29,600
perfect as perfect as it could go

122
00:05:34,469 --> 00:05:32,000
and um so you know thanks to our esa

123
00:05:36,710 --> 00:05:34,479
partners and rn spots for providing us

124
00:05:38,469 --> 00:05:36,720
with such an awesome rocket

125
00:05:41,350 --> 00:05:38,479
and then of course the hard part started

126
00:05:43,749 --> 00:05:41,360
you know the next two weeks were filled

127
00:05:45,990 --> 00:05:43,759
with these intense deployments and this

128
00:05:47,670 --> 00:05:46,000
is the first time this has ever been

129
00:05:49,110 --> 00:05:47,680
done like this in space the first time

130
00:05:51,990 --> 00:05:49,120
anything like this has been done in

131
00:05:54,070 --> 00:05:52,000
space and those deployments also went

132
00:05:56,230 --> 00:05:54,080
almost perfectly we couldn't have asked

133
00:05:58,309 --> 00:05:56,240
for a better deployment sequence and

134
00:06:00,629 --> 00:05:58,319
these engineers have built us an awesome

135
00:06:01,990 --> 00:06:00,639
telescope and then the last two weeks

136
00:06:04,550 --> 00:06:02,000
have really been filled with the

137
00:06:06,150 --> 00:06:04,560
telescope continuing to cool

138
00:06:08,230 --> 00:06:06,160

and of course it's been traveling out to

139
00:06:10,710 --> 00:06:08,240
this l2 point and really getting the

140
00:06:12,950 --> 00:06:10,720
mirrors ready for this next big phase of

141
00:06:15,909 --> 00:06:12,960
commissioning this three-month mirror

142
00:06:18,070 --> 00:06:15,919
alignment process

143
00:06:20,070 --> 00:06:18,080
wow thank you for painting that picture

144
00:06:23,430 --> 00:06:20,080
for us it sounds like it has been an

145
00:06:25,430 --> 00:06:23,440
intense past 30 days and it's incredible

146
00:06:27,590 --> 00:06:25,440
to hear how all of these teams from

147
00:06:29,830 --> 00:06:27,600
around the world honestly have had to

148
00:06:32,309 --> 00:06:29,840
work together to ensure that this

149
00:06:34,870 --> 00:06:32,319
revolutionary telescope is safe and

150
00:06:36,870 --> 00:06:34,880
sound and operating where it should be

151
00:06:39,430 --> 00:06:36,880
so like you just shared we have seen a

152
00:06:41,909 --> 00:06:39,440
successful deployment of web now and

153
00:06:44,550 --> 00:06:41,919
just today it has arrived at its final

154
00:06:46,390 --> 00:06:44,560
destination in space but before we go

155
00:06:48,710 --> 00:06:46,400
any further let's learn a little bit

156
00:06:53,430 --> 00:06:48,720
more about webb's new stable home in

157
00:06:56,870 --> 00:06:55,430
the james webb space telescope will

158
00:06:58,950 --> 00:06:56,880
perform its science mission while

159
00:07:00,550 --> 00:06:58,960
orbiting a location in space one million

160
00:07:04,070 --> 00:07:00,560
miles away from earth called the second

161
00:07:06,070 --> 00:07:04,080
lagrange point or l2 for short

162
00:07:08,070 --> 00:07:06,080
l2 is a point where the gravitational

163
00:07:09,990 --> 00:07:08,080

influences of the earth and sun and

164
00:07:11,749 --> 00:07:10,000
motion of the orbit combine to create an

165
00:07:14,309 --> 00:07:11,759
equilibrium

166
00:07:16,150 --> 00:07:14,319
as webb orbits l2 the telescope stays in

167
00:07:17,430 --> 00:07:16,160
line with earth as it travels around the

168
00:07:19,589 --> 00:07:17,440
sun

169
00:07:21,510 --> 00:07:19,599
the telescope's optics and instruments

170
00:07:23,670 --> 00:07:21,520
need to be kept very cold to be able to

171
00:07:25,589 --> 00:07:23,680
clearly observe the very faint signals

172
00:07:27,589 --> 00:07:25,599
of very distant objects

173
00:07:29,430 --> 00:07:27,599
this location is perfect for web

174
00:07:30,390 --> 00:07:29,440
sunshield to block out light and heat

175
00:07:32,790 --> 00:07:30,400
from the sun

176
00:07:34,550 --> 00:07:32,800
earth and moon unlike the hubble space

177
00:07:36,230 --> 00:07:34,560
telescope webb's orbit keeps the

178
00:07:38,390 --> 00:07:36,240
spacecraft out of the earth's shadow

179
00:07:41,110 --> 00:07:38,400
making l2 a thermally stable location

180
00:07:42,950 --> 00:07:41,120
for the observatory to operate

181
00:07:45,510 --> 00:07:42,960
webb will operate within its field of

182
00:07:47,110 --> 00:07:45,520
regard the field of regard refers to the

183
00:07:49,270 --> 00:07:47,120
angles the telescope can move while

184
00:07:51,830 --> 00:07:49,280
staying in the shadow of the sun

185
00:07:53,029 --> 00:07:51,840
each of web's instruments has its own

186
00:07:57,270 --> 00:07:53,039
field of view

187
00:07:59,270 --> 00:07:57,280
an instrument can observe

188
00:08:00,950 --> 00:07:59,280

webb's fine steering mirror is moved so

189
00:08:03,029 --> 00:08:00,960
that an object can be observed by the

190
00:08:04,710 --> 00:08:03,039
different instruments this prevents the

191
00:08:06,150 --> 00:08:04,720
whole telescope from having to re-point

192
00:08:07,510 --> 00:08:06,160
itself to do so

193
00:08:09,510 --> 00:08:07,520
the commissioning process will be

194
00:08:11,830 --> 00:08:09,520
complete approximately six months after

195
00:08:13,110 --> 00:08:11,840
launch at which time webb will start a

196
00:08:15,110 --> 00:08:13,120
science mission

197
00:08:22,790 --> 00:08:15,120
helping to uncover more of the mysteries

198
00:08:29,029 --> 00:08:25,510
so there you have it webb is in a stable

199
00:08:31,670 --> 00:08:29,039
orbit now at lagrange point two so amber

200
00:08:33,350 --> 00:08:31,680
scarlet that leads us to the big

201
00:08:35,829 --> 00:08:33,360
question for today

202
00:08:37,990 --> 00:08:35,839
what can we expect next for webb's

203
00:08:40,630 --> 00:08:38,000
mission

204
00:08:43,589 --> 00:08:40,640
well now we just continue to cool down

205
00:08:45,670 --> 00:08:43,599
uh in order for our instruments and fine

206
00:08:48,389 --> 00:08:45,680
steering mirror to function at optimal

207
00:08:50,150 --> 00:08:48,399
capacity we need to reach a set

208
00:08:51,910 --> 00:08:50,160
temperature range

209
00:08:54,389 --> 00:08:51,920
and then we'll also be aligning our

210
00:08:57,110 --> 00:08:54,399
primary mirror before moving on to the

211
00:08:59,030 --> 00:08:57,120
instrument package

212
00:09:01,030 --> 00:08:59,040
and of course after all of that comes

213
00:09:03,670 --> 00:09:01,040

the fun part i mean this is all fun but

214
00:09:06,550 --> 00:09:03,680
for me it's science the science is the

215
00:09:09,430 --> 00:09:06,560
fun part and so we expect the first

216
00:09:12,389 --> 00:09:09,440
science images from jwst to come back in

217
00:09:14,310 --> 00:09:12,399
about five months so be getting excited

218
00:09:17,190 --> 00:09:14,320
getting ready for those to come back

219
00:09:20,230 --> 00:09:17,200
later on this summer and we can expect

220
00:09:21,590 --> 00:09:20,240
really spectacularly beautiful images to

221
00:09:24,070 --> 00:09:21,600
come back from this awesome new

222
00:09:26,550 --> 00:09:24,080
telescope but beyond that they're going

223
00:09:28,710 --> 00:09:26,560
to be amazing scientifically of course

224
00:09:31,110 --> 00:09:28,720
the first year of just science

225
00:09:32,870 --> 00:09:31,120
observations has already been planned

226
00:09:35,110 --> 00:09:32,880
and we will be looking at things in the

227
00:09:36,630 --> 00:09:35,120
universe ranging from objects within our

228
00:09:38,310 --> 00:09:36,640
own solar system

229
00:09:41,030 --> 00:09:38,320
all the way out to searching for the

230
00:09:43,190 --> 00:09:41,040
very first galaxies to be born after the

231
00:09:44,790 --> 00:09:43,200
big bang and everything in time and

232
00:09:46,870 --> 00:09:44,800
space in between it's going to be

233
00:09:48,230 --> 00:09:46,880
awesome

234
00:09:50,710 --> 00:09:48,240
well i mean

235
00:09:52,790 --> 00:09:50,720
the fun has just begun and it's like

236
00:09:55,430 --> 00:09:52,800
it's very cool to hear that we already

237
00:09:58,070 --> 00:09:55,440
have this first year of science ironed

238
00:09:59,430 --> 00:09:58,080

out and i'd like to go back scarlet you

239
00:10:02,069 --> 00:09:59,440
mentioned that

240
00:10:05,590 --> 00:10:02,079
over the next five months webb will

241
00:10:07,110 --> 00:10:05,600
continue to cool down its instruments so

242
00:10:09,910 --> 00:10:07,120
web has been traveling through space for

243
00:10:11,829 --> 00:10:09,920
the past 30 days can you help which is

244
00:10:14,870 --> 00:10:11,839
already very cold so can you help us

245
00:10:17,110 --> 00:10:14,880
understand why it takes so long for web

246
00:10:19,350 --> 00:10:17,120
to continue cooling down to this correct

247
00:10:21,590 --> 00:10:19,360
temperature

248
00:10:23,509 --> 00:10:21,600
yeah that's actually a great question i

249
00:10:25,750 --> 00:10:23,519
think sometimes it's easy for us to

250
00:10:27,590 --> 00:10:25,760
assume that because it's space and it

251
00:10:30,550 --> 00:10:27,600
can get really cold

252
00:10:32,790 --> 00:10:30,560
in some places reaching absolute zero

253
00:10:35,030 --> 00:10:32,800
why wouldn't we just instantly freeze up

254
00:10:36,230 --> 00:10:35,040
right especially with this humongous sun

255
00:10:40,870 --> 00:10:36,240
shield

256
00:10:43,110 --> 00:10:40,880
our cooling rates quite a bit um but we

257
00:10:45,190 --> 00:10:43,120
have to remember that space the space

258
00:10:46,550 --> 00:10:45,200
environment is not like it is here on

259
00:10:49,110 --> 00:10:46,560
earth

260
00:10:51,829 --> 00:10:49,120
we have heat transfer processes here on

261
00:10:54,710 --> 00:10:51,839
earth like convection and conduction

262
00:10:57,190 --> 00:10:54,720
and in space we're limited to radiation

263
00:11:00,550 --> 00:10:57,200

therefore the heat dissipation takes a

264
00:11:04,790 --> 00:11:02,790
wow thank you for that explanation

265
00:11:06,710 --> 00:11:04,800
because like you said i mean

266
00:11:08,550 --> 00:11:06,720
there you can test it as much as you

267
00:11:11,030 --> 00:11:08,560
want on earth but when you get to space

268
00:11:13,910 --> 00:11:11,040
it's a whole different ballgame and so

269
00:11:15,750 --> 00:11:13,920
another thing that i want to go back to

270
00:11:17,750 --> 00:11:15,760
over this next five months is that you

271
00:11:21,590 --> 00:11:17,760
mentioned that we need to align webb's

272
00:11:24,069 --> 00:11:21,600
mirrors so these 18 hexagonal pieces all

273
00:11:26,550 --> 00:11:24,079
have to come together can you walk us

274
00:11:28,949 --> 00:11:26,560
through how that works

275
00:11:30,630 --> 00:11:28,959
right so these 18 hexagonal mirror

276
00:11:34,230 --> 00:11:30,640
segments need to be pointed in one

277
00:11:35,990 --> 00:11:34,240
direction so it can flow as one giant

278
00:11:38,710 --> 00:11:36,000
six and a half meter mirror so we can

279
00:11:40,550 --> 00:11:38,720
get as much coverage as possible um so

280
00:11:42,550 --> 00:11:40,560
now that the mirrors have been cleared

281
00:11:44,630 --> 00:11:42,560
off their launch restraints and move

282
00:11:45,829 --> 00:11:44,640
slightly away from the telescope

283
00:11:48,069 --> 00:11:45,839
structure

284
00:11:50,150 --> 00:11:48,079
starting off each segment sees

285
00:11:51,750 --> 00:11:50,160
independent light sources

286
00:11:53,430 --> 00:11:51,760
because they're essentially facing

287
00:11:55,030 --> 00:11:53,440
different directions

288
00:11:56,629 --> 00:11:55,040

so we have to align them to work

289
00:11:59,190 --> 00:11:56,639
together so right now they have

290
00:12:01,829 --> 00:11:59,200
different images and different locations

291
00:12:03,910 --> 00:12:01,839
so for example when you look at me

292
00:12:05,829 --> 00:12:03,920
you see one of me but if your eyes

293
00:12:07,670 --> 00:12:05,839
weren't working together you may see two

294
00:12:10,470 --> 00:12:07,680
of me so you can kind of think of it

295
00:12:12,069 --> 00:12:10,480
like that or say you had a hand mirror

296
00:12:13,990 --> 00:12:12,079
you were looking into and it had

297
00:12:16,310 --> 00:12:14,000
different segments and each segment was

298
00:12:18,310 --> 00:12:16,320
a slightly off you would see a distorted

299
00:12:20,629 --> 00:12:18,320
view of yourself but if it was a nice

300
00:12:22,069 --> 00:12:20,639
sleek surface then you would see an

301
00:12:24,470 --> 00:12:22,079
accurate view of yourself so you can

302
00:12:27,110 --> 00:12:24,480
think of it that way we're going to be

303
00:12:29,030 --> 00:12:27,120
using actuators and radius of curvature

304
00:12:31,350 --> 00:12:29,040
motors that are located behind each

305
00:12:33,990 --> 00:12:31,360
segment to make really small tiny

306
00:12:36,150 --> 00:12:34,000
movements moving them just microns and

307
00:12:38,150 --> 00:12:36,160
nanometers

308
00:12:40,310 --> 00:12:38,160
so our smallest movement would be about

309
00:12:43,750 --> 00:12:40,320
like 10 nanometers and i've heard that

310
00:12:46,470 --> 00:12:43,760
being described as one out of 10 000 uh

311
00:12:47,509 --> 00:12:46,480
thickness of human hair so very tiny

312
00:12:49,269 --> 00:12:47,519
movements

313
00:12:50,629 --> 00:12:49,279

that's how much control we have with

314
00:12:53,269 --> 00:12:50,639
these motors

315
00:12:54,949 --> 00:12:53,279
they provide us six degrees of freedom

316
00:12:56,150 --> 00:12:54,959
and we're going to move each mirror very

317
00:12:57,430 --> 00:12:56,160
carefully

318
00:13:00,150 --> 00:12:57,440
and we're going to determine which

319
00:13:01,829 --> 00:13:00,160
images are reflecting from which mirrors

320
00:13:04,310 --> 00:13:01,839
and then through the wavefront sensing

321
00:13:07,190 --> 00:13:04,320
control process we'll be able to achieve

322
00:13:09,670 --> 00:13:07,200
full alignment and you know fully align

323
00:13:12,470 --> 00:13:09,680
our iconic gold mirror and finally focus

324
00:13:14,710 --> 00:13:12,480
the telescope

325
00:13:16,870 --> 00:13:14,720
well thank you that was a really great

326
00:13:20,389 --> 00:13:16,880
explanation of that and to hear that the

327
00:13:22,310 --> 00:13:20,399
movement is as as thin as a human hair i

328
00:13:25,990 --> 00:13:22,320
mean the technology on this telescope

329
00:13:27,430 --> 00:13:26,000
does not cease to amaze and so um i'm

330
00:13:30,150 --> 00:13:27,440
actually going to take a step back

331
00:13:32,710 --> 00:13:30,160
because we are getting a ton of great

332
00:13:35,910 --> 00:13:32,720
questions coming in online so let's just

333
00:13:38,629 --> 00:13:35,920
get right to them our first question is

334
00:13:41,910 --> 00:13:38,639
going to come from kever kevin on

335
00:13:45,350 --> 00:13:41,920
twitter who asks approximately how long

336
00:13:48,550 --> 00:13:45,360
will jwst take to accomplish one orbit

337
00:13:53,189 --> 00:13:48,560
around lagrange 0.2 scarlin could you

338
00:13:58,550 --> 00:13:54,870

um could you repeat the last question

339
00:14:00,470 --> 00:13:58,560
the audio um cut out for me a little bit

340
00:14:02,790 --> 00:14:00,480
yeah sure thing so we have kevin on

341
00:14:05,670 --> 00:14:02,800
twitter who's wondering approximately

342
00:14:19,430 --> 00:14:05,680
how long will it take webb to accomplish

343
00:14:19,440 --> 00:14:24,870
scarlet do we still have you there

344
00:14:28,150 --> 00:14:26,790
okay it looks like we lost garland for a

345
00:14:31,430 --> 00:14:28,160
second so

346
00:14:33,110 --> 00:14:31,440
while she is uh coming back in amber do

347
00:14:34,710 --> 00:14:33,120
you happen to know the answer to this

348
00:14:36,870 --> 00:14:34,720
question

349
00:14:38,629 --> 00:14:36,880
so i don't know the exact answer off the

350
00:14:40,470 --> 00:14:38,639
top of my head well we'll need the

351
00:14:43,350 --> 00:14:40,480
engineer back to answer that remember

352
00:14:45,829 --> 00:14:43,360
i'm an astronomer um but i what i do

353
00:14:48,790 --> 00:14:45,839
know is that that orbit around the l2

354
00:14:51,670 --> 00:14:48,800
point it's a huge orbit um and so it

355
00:14:54,629 --> 00:14:51,680
sort of orbits around this uh sort of

356
00:14:56,870 --> 00:14:54,639
you know imaginary l2 stationary point

357
00:15:00,470 --> 00:14:56,880
uh during the course of its orbit around

358
00:15:02,949 --> 00:15:00,480
the sun so um the telescope essentially

359
00:15:04,870 --> 00:15:02,959
orbits the sun in line with the earth

360
00:15:06,790 --> 00:15:04,880
and it takes of course a year

361
00:15:08,870 --> 00:15:06,800
to make that orbit around the earth or

362
00:15:10,949 --> 00:15:08,880
around the sun along with the earth but

363
00:15:14,310 --> 00:15:10,959

then yeah along the way it's making this

364
00:15:16,710 --> 00:15:14,320
uh long a big circular orbit around the

365
00:15:18,629 --> 00:15:16,720
l2 point

366
00:15:20,629 --> 00:15:18,639
great thank you so much for that and

367
00:15:22,790 --> 00:15:20,639
when scarlet comes back kevin we will be

368
00:15:24,870 --> 00:15:22,800
sure to see if we can get the answer to

369
00:15:27,350 --> 00:15:24,880
this question for you so let's move on

370
00:15:30,389 --> 00:15:27,360
we have stan on facebook amber that's

371
00:15:32,310 --> 00:15:30,399
got a great astronomy question uh he

372
00:15:33,990 --> 00:15:32,320
wants to know can you tell us a little

373
00:15:37,189 --> 00:15:34,000
bit more about the decision-making

374
00:15:40,230 --> 00:15:37,199
process involved with selecting webb's

375
00:15:42,470 --> 00:15:40,240
targets and who decides the priority and

376
00:15:44,470 --> 00:15:42,480
allocates time for each of these points

377
00:15:47,269 --> 00:15:44,480
of interest

378
00:15:50,230 --> 00:15:47,279
that is a great question and the answer

379
00:15:52,389 --> 00:15:50,240
is that it is purely uh sort of

380
00:15:55,829 --> 00:15:52,399
democratic anyone in the world can

381
00:15:57,829 --> 00:15:55,839
propose their best idea on where to

382
00:15:59,590 --> 00:15:57,839
point this telescope that's how it works

383
00:16:01,670 --> 00:15:59,600
with hubble right now and that's how

384
00:16:03,509 --> 00:16:01,680
it's going to work with jrc coming up in

385
00:16:06,150 --> 00:16:03,519
the very near future

386
00:16:07,749 --> 00:16:06,160
so basically once a year astronomers

387
00:16:10,550 --> 00:16:07,759
from around the world sort of get

388
00:16:12,310 --> 00:16:10,560

together and think up their best ideas

389
00:16:13,910 --> 00:16:12,320
of where to point the telescope so that

390
00:16:16,389 --> 00:16:13,920
we can you know learn new things about

391
00:16:18,790 --> 00:16:16,399
the universe and they write proposals

392
00:16:20,790 --> 00:16:18,800
submit the proposals and then another

393
00:16:23,110 --> 00:16:20,800
team of astronomers

394
00:16:25,670 --> 00:16:23,120
reviews the proposals and sort of ranks

395
00:16:27,670 --> 00:16:25,680
them and this is all done anonymously so

396
00:16:29,829 --> 00:16:27,680
there's you know uh you know striving to

397
00:16:32,949 --> 00:16:29,839
be fairness in the process so that at

398
00:16:35,189 --> 00:16:32,959
the end of the day the best ideas get uh

399
00:16:36,389 --> 00:16:35,199
get prioritized and that's who gets time

400
00:16:38,710 --> 00:16:36,399
on the telescope

401
00:16:41,430 --> 00:16:38,720
now the really great thing about this

402
00:16:43,829 --> 00:16:41,440
data that's going to come back from jwst

403
00:16:46,389 --> 00:16:43,839
same thing with hubble is that

404
00:16:48,550 --> 00:16:46,399
a lot of times the astronomers who win

405
00:16:50,790 --> 00:16:48,560
time get a certain amount of

406
00:16:54,069 --> 00:16:50,800
proprietary time so they get access to

407
00:16:54,870 --> 00:16:54,079
the data for six months maybe a year

408
00:16:57,350 --> 00:16:54,880
but

409
00:16:59,990 --> 00:16:57,360
after a year it all becomes public so

410
00:17:02,230 --> 00:17:00,000
anyone in the world can use that data to

411
00:17:03,990 --> 00:17:02,240
do science which is awesome

412
00:17:07,189 --> 00:17:04,000
and then a lot of the data that's taken

413
00:17:09,669 --> 00:17:07,199

during the first year of jwst's lifetime

414
00:17:11,909 --> 00:17:09,679
particularly during the first few months

415
00:17:14,630 --> 00:17:11,919
is going to be available immediately to

416
00:17:20,549 --> 00:17:17,350
wow i mean there was so much awesomeness

417
00:17:21,909 --> 00:17:20,559
in that it's so cool to hear that webb's

418
00:17:23,590 --> 00:17:21,919
data one

419
00:17:26,230 --> 00:17:23,600
this was already such an international

420
00:17:29,029 --> 00:17:26,240
mission and that this incredible piece

421
00:17:31,029 --> 00:17:29,039
of technology gets to you be used and

422
00:17:33,909 --> 00:17:31,039
the love is shared by everyone around

423
00:17:34,870 --> 00:17:33,919
the world and to actually follow up to

424
00:17:39,350 --> 00:17:34,880
that

425
00:17:42,230 --> 00:17:39,360
webb will be looking at in some of its

426
00:17:45,909 --> 00:17:42,240
targets steve on twitter is wondering

427
00:17:49,430 --> 00:17:45,919
will jw jwst look at objects in our own

428
00:17:52,950 --> 00:17:49,440
solar system as well

429
00:17:56,710 --> 00:17:52,960
absolutely so generously has the ability

430
00:17:58,950 --> 00:17:56,720
to look at objects from mars on out so

431
00:18:01,510 --> 00:17:58,960
it can't of course again it's orbiting

432
00:18:03,510 --> 00:18:01,520
just outside the orbit of the of the the

433
00:18:05,990 --> 00:18:03,520
moon about it's about four times further

434
00:18:08,310 --> 00:18:06,000
away than the moon um so it always has

435
00:18:10,630 --> 00:18:08,320
to be pointed out towards deep space it

436
00:18:12,710 --> 00:18:10,640
can't ever look back towards the earth

437
00:18:14,630 --> 00:18:12,720
so for example it could never observe

438
00:18:17,510 --> 00:18:14,640

mercury and venus

439
00:18:20,390 --> 00:18:17,520
but it can observe mars and everything

440
00:18:23,110 --> 00:18:20,400
on out and in fact during that first

441
00:18:25,510 --> 00:18:23,120
year of observations we have detailed

442
00:18:28,310 --> 00:18:25,520
plans to look at lots of objects in our

443
00:18:30,870 --> 00:18:28,320
solar system from mars some of the um

444
00:18:32,950 --> 00:18:30,880
the moons of the outer planets um so

445
00:18:35,430 --> 00:18:32,960
there's a whole list that you can find

446
00:18:38,150 --> 00:18:35,440
online of objects within our solar

447
00:18:41,430 --> 00:18:38,160
system that jbst is planning to study

448
00:18:45,990 --> 00:18:43,750
nice and you say that we can look online

449
00:18:48,070 --> 00:18:46,000
is there a specific website that people

450
00:18:49,830 --> 00:18:48,080
should look forward to to find this

451
00:18:51,990 --> 00:18:49,840
information

452
00:18:54,070 --> 00:18:52,000
absolutely so the space telescope

453
00:18:56,549 --> 00:18:54,080
science institute is where our mission

454
00:18:58,990 --> 00:18:56,559
operations center is located and if you

455
00:19:00,549 --> 00:18:59,000
go on their uh website

456
00:19:02,870 --> 00:19:00,559
stsci.edu

457
00:19:04,630 --> 00:19:02,880
that's where they have listed all of the

458
00:19:07,270 --> 00:19:04,640
different observing programs that are

459
00:19:08,950 --> 00:19:07,280
planned for the first year so you may

460
00:19:10,870 --> 00:19:08,960
have to go a link or too deep but you

461
00:19:14,630 --> 00:19:10,880
should be able to find it pretty easily

462
00:19:17,110 --> 00:19:14,640
or you can just google jwst cycle one so

463
00:19:19,110 --> 00:19:17,120

we call the cycles year by year so cycle

464
00:19:21,669 --> 00:19:19,120
one observations are what that first

465
00:19:23,110 --> 00:19:21,679
year is going to be

466
00:19:24,789 --> 00:19:23,120
thank you so much for sharing that i

467
00:19:26,310 --> 00:19:24,799
know a ton of viewers are going to be

468
00:19:30,150 --> 00:19:26,320
excited to hear that because that is a

469
00:19:30,870 --> 00:19:30,160
question we get so often on social media

470
00:19:32,870 --> 00:19:30,880
so

471
00:19:36,310 --> 00:19:32,880
amber we have another question from

472
00:19:39,190 --> 00:19:36,320
facebook danielle asks is the exposure

473
00:19:43,110 --> 00:19:39,200
time in infrared different than it is in

474
00:19:45,190 --> 00:19:43,120
visible light for data acquisition

475
00:19:46,870 --> 00:19:45,200
absolutely so the wavelength the

476
00:19:49,669 --> 00:19:46,880
wavelength of light that you're looking

477
00:19:52,150 --> 00:19:49,679
at always does come into play uh when

478
00:19:54,310 --> 00:19:52,160
you're planning these observations

479
00:19:56,230 --> 00:19:54,320
and that's for several different reasons

480
00:19:58,710 --> 00:19:56,240
but one of the fundamental reasons is

481
00:20:00,710 --> 00:19:58,720
just because objects in the universe

482
00:20:03,110 --> 00:20:00,720
emit these different wavelengths of

483
00:20:05,430 --> 00:20:03,120
light at sort of different strengths

484
00:20:07,830 --> 00:20:05,440
okay so you can think of one object

485
00:20:08,630 --> 00:20:07,840
might not be very bright in the visible

486
00:20:11,110 --> 00:20:08,640
light

487
00:20:12,789 --> 00:20:11,120
but might be in in emitting a lot of

488
00:20:15,350 --> 00:20:12,799

infrared light and in fact some of the

489
00:20:17,190 --> 00:20:15,360
things we want to look at with jbst

490
00:20:19,909 --> 00:20:17,200
are going to be great to observe with

491
00:20:21,510 --> 00:20:19,919
this telescope for that specific reason

492
00:20:23,510 --> 00:20:21,520
that you can't really see them in

493
00:20:25,669 --> 00:20:23,520
visible light or other wavelengths but

494
00:20:28,070 --> 00:20:25,679
you can see them in infrared light and

495
00:20:30,310 --> 00:20:28,080
so yes because objects emit a different

496
00:20:32,470 --> 00:20:30,320
sort of power at different parts of the

497
00:20:34,310 --> 00:20:32,480
wavelength range means that we'll have

498
00:20:37,350 --> 00:20:34,320
to sort of calculate those different

499
00:20:41,350 --> 00:20:39,669
and you can see right now actually uh

500
00:20:43,350 --> 00:20:41,360
one of the one of the things i love

501
00:20:45,430 --> 00:20:43,360
about these these infrared images people

502
00:20:47,830 --> 00:20:45,440
always ask if they're going to be pretty

503
00:20:50,310 --> 00:20:47,840
which is a valid question uh and this uh

504
00:20:52,470 --> 00:20:50,320
what you see on the screen now is a near

505
00:20:55,270 --> 00:20:52,480
infrared image from hubble so hubble has

506
00:20:57,510 --> 00:20:55,280
a little bit of capability in the near

507
00:21:00,149 --> 00:20:57,520
infrared and this is a near-infrared

508
00:21:01,830 --> 00:21:00,159
image of the uh the eagle nebula are

509
00:21:04,710 --> 00:21:01,840
often called the pillars of creation

510
00:21:07,669 --> 00:21:04,720
from hubble and um what infrared light

511
00:21:09,750 --> 00:21:07,679
allows us to do is essentially peer down

512
00:21:12,470 --> 00:21:09,760
into those dust clouds that you can't

513
00:21:14,710 --> 00:21:12,480

see through with with visible light and

514
00:21:16,950 --> 00:21:14,720
allows us to see the the stars being

515
00:21:19,110 --> 00:21:16,960
born so when people ask these pictures

516
00:21:20,950 --> 00:21:19,120
are going to be pretty i always point

517
00:21:22,870 --> 00:21:20,960
them to this image because isn't this

518
00:21:26,470 --> 00:21:22,880
this is like a beautiful beautiful

519
00:21:32,230 --> 00:21:29,590
i completely agree and oh hey scarlet so

520
00:21:34,710 --> 00:21:32,240
glad to see you back online clinical

521
00:21:36,950 --> 00:21:34,720
difficulties no

522
00:21:38,470 --> 00:21:36,960
no worries at all

523
00:21:40,710 --> 00:21:38,480
uh amber i'm going to talk to you one

524
00:21:43,029 --> 00:21:40,720
more question kind of in the same light

525
00:21:46,470 --> 00:21:43,039
uh we have mark on facebook who wants to

526
00:21:48,630 --> 00:21:46,480
know that due to webb's position at l2

527
00:21:50,710 --> 00:21:48,640
is there anything we won't be able to

528
00:21:52,789 --> 00:21:50,720
see

529
00:21:55,430 --> 00:21:52,799
yeah so i i kind of touched on this a

530
00:21:58,710 --> 00:21:55,440
little bit but but because it is at that

531
00:22:00,789 --> 00:21:58,720
part of space it and because it's an

532
00:22:03,029 --> 00:22:00,799
infrared telescope of course the mirrors

533
00:22:05,510 --> 00:22:03,039
always have to be pointing outward away

534
00:22:07,510 --> 00:22:05,520
from the sun um we can't ever point the

535
00:22:10,149 --> 00:22:07,520
telescope back towards the sun because

536
00:22:12,950 --> 00:22:10,159
that would essentially fry our detectors

537
00:22:15,830 --> 00:22:12,960
uh and so that means we can't look back

538
00:22:17,669 --> 00:22:15,840

at the moon the earth venus mercury or

539
00:22:19,590 --> 00:22:17,679
the sun itself of course uh but

540
00:22:22,149 --> 00:22:19,600
everything else uh from the orbit of

541
00:22:24,390 --> 00:22:22,159
mars on out is fair game for for this

542
00:22:26,470 --> 00:22:24,400
telescope

543
00:22:28,549 --> 00:22:26,480
wow i mean that

544
00:22:30,789 --> 00:22:28,559
that gives us a lot to look at thank you

545
00:22:32,390 --> 00:22:30,799
so much and so scarlet amber was just

546
00:22:36,630 --> 00:22:32,400
telling us a little bit about what we

547
00:22:38,149 --> 00:22:36,640
can expect for web 2 image and how that

548
00:22:40,149 --> 00:22:38,159
process really works between the

549
00:22:42,710 --> 00:22:40,159
infrared and the visible light but we

550
00:22:45,190 --> 00:22:42,720
have a question from mike t on youtube

551
00:22:48,230 --> 00:22:45,200
who asks how long does it take for

552
00:22:51,830 --> 00:22:48,240
communications to transfer to and from

553
00:22:54,230 --> 00:22:51,840
the telescope do you have any insight on

554
00:22:56,950 --> 00:22:54,240
on that

555
00:22:58,710 --> 00:22:56,960
well that's a very specific question um

556
00:23:02,310 --> 00:22:58,720
i would probably have to defer that one

557
00:23:03,909 --> 00:23:02,320
to the com team but we use these massive

558
00:23:05,909 --> 00:23:03,919
powerful

559
00:23:08,470 --> 00:23:05,919
antennas from the ground

560
00:23:11,029 --> 00:23:08,480
to relay the signal from the

561
00:23:12,149 --> 00:23:11,039
computers in the mission operations

562
00:23:15,029 --> 00:23:12,159
center

563
00:23:16,789 --> 00:23:15,039

to the telescope so from the control

564
00:23:19,350 --> 00:23:16,799
center we are sending commands to the

565
00:23:21,350 --> 00:23:19,360
telescope any activity that that it

566
00:23:22,950 --> 00:23:21,360
performs we're commanding from the

567
00:23:23,990 --> 00:23:22,960
control center

568
00:23:26,710 --> 00:23:24,000
and then

569
00:23:28,149 --> 00:23:26,720
once the telescope performs what it

570
00:23:30,789 --> 00:23:28,159
needs to do

571
00:23:33,990 --> 00:23:30,799
we are monitoring real-time telemetry

572
00:23:39,510 --> 00:23:37,350
wow thank you and so back back to just

573
00:23:41,029 --> 00:23:39,520
monitoring this telescope systems and a

574
00:23:43,110 --> 00:23:41,039
little bit earlier you mentioned that in

575
00:23:43,909 --> 00:23:43,120
the immediate future the next five

576
00:23:46,070 --> 00:23:43,919
months

577
00:23:47,750 --> 00:23:46,080
we web will need to cool down to a

578
00:23:50,070 --> 00:23:47,760
specific temperature in order for its

579
00:23:52,390 --> 00:23:50,080
instruments to work and so we have

580
00:23:55,750 --> 00:23:52,400
anthony on instagram who wants to know

581
00:23:57,830 --> 00:23:55,760
if specifically how much time till web

582
00:23:59,510 --> 00:23:57,840
actually cools down to this correct

583
00:24:01,909 --> 00:23:59,520
temperature

584
00:24:04,870 --> 00:24:01,919
right so it's about 40 kelvin i believe

585
00:24:06,390 --> 00:24:04,880
it takes about 98 days for uh the

586
00:24:09,029 --> 00:24:06,400
instrument's mirror to cool down to

587
00:24:14,870 --> 00:24:09,990
that is

588
00:24:17,669 --> 00:24:14,880

and so

589
00:24:20,549 --> 00:24:17,679
yeah and a follow-up um twit app on

590
00:24:23,750 --> 00:24:20,559
twitter asks has the gradual cooling

591
00:24:26,230 --> 00:24:23,760
down over wet of webb over the last week

592
00:24:27,510 --> 00:24:26,240
been according to the simulations has it

593
00:24:29,750 --> 00:24:27,520
happened

594
00:24:31,590 --> 00:24:29,760
as you all thought it would

595
00:24:34,630 --> 00:24:31,600
yeah of course it's never perfect

596
00:24:36,310 --> 00:24:34,640
because it is a simulation um but yes it

597
00:24:39,110 --> 00:24:36,320
has been um

598
00:24:42,789 --> 00:24:39,120
almost as just as expected

599
00:24:45,350 --> 00:24:42,799
we have had our cooling rate uh increase

600
00:24:48,310 --> 00:24:45,360
quite a lot from the deployment of the

601
00:24:51,190 --> 00:24:48,320
sunshield and everything is going uh

602
00:24:53,750 --> 00:24:51,200
marvelous really

603
00:24:55,909 --> 00:24:53,760
nice i mean that is what we love to hear

604
00:24:57,590 --> 00:24:55,919
and hope it continues that way over

605
00:24:59,110 --> 00:24:57,600
these next five and a half months you

606
00:25:02,149 --> 00:24:59,120
know fingers crossed

607
00:25:04,870 --> 00:25:02,159
and so another question we have is from

608
00:25:10,950 --> 00:25:04,880
justin on twitter who asks are there

609
00:25:13,830 --> 00:25:10,960
other observatories in l2 besides jwst

610
00:25:15,350 --> 00:25:13,840
uh scarlet you want to take this one

611
00:25:16,390 --> 00:25:15,360
amber do you want to take this one

612
00:25:17,510 --> 00:25:16,400
actually

613
00:25:20,149 --> 00:25:17,520

sure

614
00:25:22,149 --> 00:25:20,159
yeah yeah so um there are there are

615
00:25:25,830 --> 00:25:22,159
other observatories out in this part of

616
00:25:28,549 --> 00:25:25,840
space um uh there's a the european gaia

617
00:25:32,070 --> 00:25:28,559
observatory is um out in this part of

618
00:25:35,269 --> 00:25:32,080
space and in fact we've been able to uh

619
00:25:37,110 --> 00:25:35,279
to learn about for example the micro

620
00:25:39,110 --> 00:25:37,120
meteorite situation in that part of

621
00:25:41,430 --> 00:25:39,120
space thanks to some of these other

622
00:25:43,269 --> 00:25:41,440
satellites so that's a question i get a

623
00:25:45,269 --> 00:25:43,279
lot is are we worried about micro

624
00:25:47,190 --> 00:25:45,279
meteorite impacts in that part of space

625
00:25:49,510 --> 00:25:47,200
and and the the short answer to that is

626
00:25:51,510 --> 00:25:49,520
no not really um because it's a

627
00:25:53,110 --> 00:25:51,520
semi-stable point stuff doesn't tend to

628
00:25:54,870 --> 00:25:53,120
collect there but part of the reason

629
00:25:56,789 --> 00:25:54,880
that we know that for sure is because

630
00:25:58,310 --> 00:25:56,799
we've been able to sort of assess it

631
00:26:00,549 --> 00:25:58,320
from other spacecraft that are in that

632
00:26:03,909 --> 00:26:00,559
part of space so yes we do have other

633
00:26:05,750 --> 00:26:03,919
satellites out in that part of space

634
00:26:07,590 --> 00:26:05,760
nice thank you thank you so much for

635
00:26:09,830 --> 00:26:07,600
that and so and thank you too to

636
00:26:11,590 --> 00:26:09,840
everyone submitting your questions today

637
00:26:13,430 --> 00:26:11,600
if you are just tuning in we really

638
00:26:15,990 --> 00:26:13,440

encourage you to participate live in

639
00:26:17,750 --> 00:26:16,000
today's show by dropping a question in

640
00:26:20,630 --> 00:26:17,760
the chat stream wherever you're watching

641
00:26:24,070 --> 00:26:20,640
from or by using the hashtag unfold the

642
00:26:25,669 --> 00:26:24,080
universe on social media scarlin amber

643
00:26:28,630 --> 00:26:25,679
don't go anywhere we will get back to

644
00:26:30,630 --> 00:26:28,640
you in just a second but first we have

645
00:26:33,190 --> 00:26:30,640
another way for those watching to

646
00:26:35,590 --> 00:26:33,200
participate in the web mission

647
00:26:38,149 --> 00:26:35,600
we know that five months is a long time

648
00:26:39,510 --> 00:26:38,159
to wait and wonder about what webb will

649
00:26:41,350 --> 00:26:39,520
discover

650
00:26:44,470 --> 00:26:41,360
show us what you believe the web

651
00:26:47,830 --> 00:26:44,480
telescope will reveal by creating art

652
00:26:50,230 --> 00:26:47,840
you can sing you can paint you can dance

653
00:26:53,590 --> 00:26:50,240
the universe is literally the limit in

654
00:26:56,070 --> 00:26:53,600
this case so share a picture or video of

655
00:26:58,789 --> 00:26:56,080
you and your creation online using the

656
00:27:00,870 --> 00:26:58,799
hashtag unfold the universe you'll have

657
00:27:04,390 --> 00:27:00,880
a chance to be featured on nasa's social

658
00:27:07,029 --> 00:27:04,400
media page and also the nasa website

659
00:27:09,029 --> 00:27:07,039
take a look at how it works

660
00:27:11,190 --> 00:27:09,039
hi everyone i'm kelly girardi and this

661
00:27:13,269 --> 00:27:11,200
is delta v and we're kicking off the

662
00:27:15,190 --> 00:27:13,279
unfold the universe challenge with nasa

663
00:27:17,029 --> 00:27:15,200

and the james webb space telescope the

664
00:27:19,510 --> 00:27:17,039
webb telescope is nasa's biggest and

665
00:27:21,190 --> 00:27:19,520
most powerful space telescope ever it's

666
00:27:22,470 --> 00:27:21,200
going to help reveal our universe like

667
00:27:24,389 --> 00:27:22,480
never before

668
00:27:26,710 --> 00:27:24,399
delta what do you think we'll discover i

669
00:27:29,669 --> 00:27:26,720
think we'll see stars plants and

670
00:27:31,909 --> 00:27:29,679
galaxies i can't wait

671
00:27:33,990 --> 00:27:31,919
nasa is hosting an unfold the universe

672
00:27:35,750 --> 00:27:34,000
art challenge use your imagination to

673
00:27:38,230 --> 00:27:35,760
share what you believe the web telescope

674
00:27:40,630 --> 00:27:38,240
will find it could be a drawing a poem a

675
00:27:42,389 --> 00:27:40,640
song you could be creative i took a

676
00:27:44,470 --> 00:27:42,399
picture of why i think to tell the

677
00:27:47,029 --> 00:27:44,480
scenes this is the telescope and these

678
00:27:48,630 --> 00:27:47,039
are our plants and stars wow delta it's

679
00:27:50,310 --> 00:27:48,640
beautiful i can't wait to see what

680
00:27:52,310 --> 00:27:50,320
everyone else comes up with you can

681
00:27:54,310 --> 00:27:52,320
share a photo or a video of your art and

682
00:27:57,269 --> 00:27:54,320
what you think webb will discover using

683
00:28:02,070 --> 00:27:57,279
the hashtag unfolds the universe go

684
00:28:06,710 --> 00:28:05,029
i love this art challenge so much i have

685
00:28:08,470 --> 00:28:06,720
had the amazing honor of being one of

686
00:28:10,630 --> 00:28:08,480
the people that gets to sift through

687
00:28:13,750 --> 00:28:10,640
some of these submissions and each

688
00:28:15,510 --> 00:28:13,760

creation has been so incredibly unique

689
00:28:17,110 --> 00:28:15,520
and really just showcased people's

690
00:28:19,669 --> 00:28:17,120
individuality

691
00:28:21,510 --> 00:28:19,679
it's been inspiring to see everyone's

692
00:28:24,149 --> 00:28:21,520
wonder and creativity from around the

693
00:28:26,149 --> 00:28:24,159
world people of all ages and from so

694
00:28:28,789 --> 00:28:26,159
many different countries for everyone

695
00:28:31,269 --> 00:28:28,799
that has already contributed thank you

696
00:28:34,389 --> 00:28:31,279
who knows maybe your creation really

697
00:28:36,710 --> 00:28:34,399
will be what web reveals so keep them

698
00:28:39,590 --> 00:28:36,720
coming online you can submit them using

699
00:28:42,710 --> 00:28:39,600
the hashtag unfold the universe we love

700
00:28:44,950 --> 00:28:42,720
to see them so we encourage you to join

701
00:28:47,190 --> 00:28:44,960
okay let's bring back amber and scarlen

702
00:28:49,510 --> 00:28:47,200
because we still have so many great

703
00:28:53,029 --> 00:28:49,520
questions coming in online

704
00:28:57,029 --> 00:28:53,039
so the next question we have is a person

705
00:28:59,590 --> 00:28:57,039
on twitter who asks will jwst look at

706
00:29:02,070 --> 00:28:59,600
the hubble deep fields amber

707
00:29:04,950 --> 00:29:02,080
this is a perfect one for you

708
00:29:08,230 --> 00:29:04,960
will they will they be able to see it

709
00:29:12,149 --> 00:29:08,240
yes absolutely in fact one of the

710
00:29:14,389 --> 00:29:12,159
primary drivers for building jwst back

711
00:29:16,710 --> 00:29:14,399
you know years ago a couple decades ago

712
00:29:18,789 --> 00:29:16,720
was to be able to find the very first

713
00:29:21,590 --> 00:29:18,799

galaxies that were born after the big

714
00:29:23,830 --> 00:29:21,600
bang and by looking at images like the

715
00:29:25,750 --> 00:29:23,840
hubble deep field ultra deep field we've

716
00:29:28,149 --> 00:29:25,760
been able to push back and see very

717
00:29:30,389 --> 00:29:28,159
distant galaxies but at some point we

718
00:29:33,990 --> 00:29:30,399
sort of come to the edge of what hubble

719
00:29:37,269 --> 00:29:34,000
can see and jwst was specifically

720
00:29:39,510 --> 00:29:37,279
designed to help us find those first

721
00:29:40,389 --> 00:29:39,520
galaxies beyond what hubble is capable

722
00:29:42,630 --> 00:29:40,399
of seeing

723
00:29:44,389 --> 00:29:42,640
and the hubble ultra deep field and some

724
00:29:45,590 --> 00:29:44,399
of the other deep fields that hubble has

725
00:29:48,070 --> 00:29:45,600
observed

726
00:29:50,710 --> 00:29:48,080
are these places in in space that are

727
00:29:52,710 --> 00:29:50,720
incredibly rich in data so not only do

728
00:29:54,950 --> 00:29:52,720
we have data from hubble we have data

729
00:29:57,350 --> 00:29:54,960
from other observatories we have x-ray

730
00:30:00,710 --> 00:29:57,360
data from chandra we have uh infrared

731
00:30:02,070 --> 00:30:00,720
data uh also from spitzer and so all and

732
00:30:03,990 --> 00:30:02,080
all all different kinds all different

733
00:30:06,070 --> 00:30:04,000
wavelengths of data in these fields and

734
00:30:09,590 --> 00:30:06,080
so the fields themselves are incredibly

735
00:30:12,549 --> 00:30:09,600
rich and adding jwst's deep infrared

736
00:30:14,789 --> 00:30:12,559
data on top is going to help us both

737
00:30:16,950 --> 00:30:14,799
hopefully find those very first galaxies

738
00:30:19,190 --> 00:30:16,960

to be born over 13 and a half billion

739
00:30:21,110 --> 00:30:19,200
years ago as well as just add to the

740
00:30:23,430 --> 00:30:21,120
depth of knowledge that we can learn

741
00:30:27,830 --> 00:30:23,440
about galaxies and about galaxy

742
00:30:34,149 --> 00:30:31,750
wow i mean you mentioned 13.5 billion

743
00:30:36,789 --> 00:30:34,159
years it is just incredible what this

744
00:30:38,389 --> 00:30:36,799
telescope can see and so we've talked

745
00:30:40,470 --> 00:30:38,399
about hubble deep fields we've talked

746
00:30:42,310 --> 00:30:40,480
about some of these first observations

747
00:30:45,430 --> 00:30:42,320
and that leads me to a really great

748
00:30:47,830 --> 00:30:45,440
question from w.f swigert on youtube uh

749
00:30:50,230 --> 00:30:47,840
scarlet this is a great one for you are

750
00:30:53,269 --> 00:30:50,240
the mirror alignments and adjust and

751
00:30:55,190 --> 00:30:53,279
adjustments intended to be permanent or

752
00:30:59,590 --> 00:30:55,200
will they need to be some adjustments

753
00:31:02,710 --> 00:30:59,600
depending on what web decides to look at

754
00:31:04,950 --> 00:31:02,720
yeah so um where it's designed to be

755
00:31:07,110 --> 00:31:04,960
adjusted anytime that it needs to be

756
00:31:09,110 --> 00:31:07,120
anytime that it needs to be so we will

757
00:31:11,830 --> 00:31:09,120
have to align them

758
00:31:14,470 --> 00:31:11,840
throughout the life of the mission

759
00:31:16,470 --> 00:31:14,480
so it's not just right now it's it's a

760
00:31:18,389 --> 00:31:16,480
continuous process

761
00:31:21,110 --> 00:31:18,399
just to make sure that they're always

762
00:31:22,870 --> 00:31:21,120
perfectly aligned

763
00:31:24,870 --> 00:31:22,880

wow it's really like we really do have

764
00:31:26,310 --> 00:31:24,880
our own little transformer in space

765
00:31:28,789 --> 00:31:26,320
that's so cool

766
00:31:30,870 --> 00:31:28,799
um and so

767
00:31:31,590 --> 00:31:30,880
oh i have a great question for both of

768
00:31:37,190 --> 00:31:31,600
you

769
00:31:39,830 --> 00:31:37,200
well states hi my 10 year old son dara

770
00:31:42,070 --> 00:31:39,840
is an inspiring engineer and is really

771
00:31:44,389 --> 00:31:42,080
inspired to watch you tonight what

772
00:31:47,509 --> 00:31:44,399
advice would you give for him to someday

773
00:31:50,389 --> 00:31:47,519
work on projects like this scarlan as

774
00:31:51,430 --> 00:31:50,399
our engineer do you want to kick it off

775
00:31:52,950 --> 00:31:51,440
sure

776
00:31:55,029 --> 00:31:52,960
i would say

777
00:31:56,470 --> 00:31:55,039
work very hard

778
00:31:59,830 --> 00:31:56,480
don't give up

779
00:32:04,310 --> 00:31:59,840
engineering can be hard for a reason but

780
00:32:07,269 --> 00:32:04,320
then we get amazing gifts like jwst so

781
00:32:09,350 --> 00:32:07,279
it's always worth it um just continue on

782
00:32:11,350 --> 00:32:09,360
your path make sure you have a great

783
00:32:14,470 --> 00:32:11,360
support system

784
00:32:17,029 --> 00:32:14,480
and like i said never give up reach for

785
00:32:19,590 --> 00:32:17,039
the stars

786
00:32:22,070 --> 00:32:19,600
oh i love it and then amber you know we

787
00:32:24,070 --> 00:32:22,080
also have a lot of aspiring scientists

788
00:32:25,909 --> 00:32:24,080

do you have any advice for anyone out

789
00:32:28,389 --> 00:32:25,919
there who might want to follow your

790
00:32:30,149 --> 00:32:28,399
footsteps one day

791
00:32:31,990 --> 00:32:30,159
yeah well scarlet just gave some really

792
00:32:35,830 --> 00:32:32,000
great great advice and i think that

793
00:32:37,509 --> 00:32:35,840
holds for for science as well um and one

794
00:32:39,269 --> 00:32:37,519
specific thing she mentioned that's been

795
00:32:40,710 --> 00:32:39,279
really important for me is that support

796
00:32:43,269 --> 00:32:40,720
network so

797
00:32:45,750 --> 00:32:43,279
i know that mentors have been incredibly

798
00:32:48,470 --> 00:32:45,760
important uh to me to help me you know

799
00:32:50,470 --> 00:32:48,480
get to where i am in my career and so i

800
00:32:52,549 --> 00:32:50,480
think it's super important to find

801
00:32:53,830 --> 00:32:52,559
people all along the way no matter what

802
00:32:55,350 --> 00:32:53,840
stage you are

803
00:32:57,830 --> 00:32:55,360
in your in your education and your

804
00:32:59,590 --> 00:32:57,840
learning to find people that um are

805
00:33:01,830 --> 00:32:59,600
willing to help you and support you and

806
00:33:04,070 --> 00:33:01,840
sort of help you make it to the next

807
00:33:05,669 --> 00:33:04,080
step because none of us do any of this

808
00:33:07,590 --> 00:33:05,679
by ourselves you know it's it's a group

809
00:33:10,310 --> 00:33:07,600
effort for sure so find good mentors

810
00:33:12,470 --> 00:33:10,320
that is probably my top piece of advice

811
00:33:15,029 --> 00:33:12,480
and then if i could jump back to a

812
00:33:17,269 --> 00:33:15,039
previous question uh because i now have

813
00:33:20,070 --> 00:33:17,279

an answer so one of our engineers uh

814
00:33:22,789 --> 00:33:20,080
texted me thank you mike menzel um and

815
00:33:25,669 --> 00:33:22,799
said that the time it takes to orbit l2

816
00:33:28,389 --> 00:33:25,679
is 180 days which i didn't know until

817
00:33:31,350 --> 00:33:28,399
just now so it actually takes half a

818
00:33:33,830 --> 00:33:31,360
year almost to make that full complete

819
00:33:35,430 --> 00:33:33,840
orbit around l2 so i knew it was a long

820
00:33:38,789 --> 00:33:35,440
time i didn't quite realize it was that

821
00:33:40,310 --> 00:33:38,799
long so super interesting

822
00:33:41,269 --> 00:33:40,320
yeah wow thank you for that and thank

823
00:33:45,110 --> 00:33:41,279
you mike

824
00:33:47,029 --> 00:33:45,120
um and so moving on we have a

825
00:33:49,509 --> 00:33:47,039
oh we have a great question from penny

826
00:33:51,669 --> 00:33:49,519
on facebook um

827
00:33:54,230 --> 00:33:51,679
amber if you want to take this one feel

828
00:33:56,549 --> 00:33:54,240
free it she wants to know how will the

829
00:33:59,110 --> 00:33:56,559
public access the images once they're

830
00:34:03,830 --> 00:34:01,029
yeah so that's that's a great question

831
00:34:06,230 --> 00:34:03,840
um that also will be housed at the space

832
00:34:09,030 --> 00:34:06,240
telescope science institute um which is

833
00:34:12,149 --> 00:34:09,040
where scarlet works uh so they um they

834
00:34:14,629 --> 00:34:12,159
are our sort of um repository for for

835
00:34:16,950 --> 00:34:14,639
housing the data uh for the telescope

836
00:34:20,069 --> 00:34:16,960
also for hubble um so that will be the

837
00:34:22,310 --> 00:34:20,079
place to go to get the all of the images

838
00:34:24,230 --> 00:34:22,320

and of course as we make discoveries as

839
00:34:26,950 --> 00:34:24,240
astronomers make discoveries along the

840
00:34:28,869 --> 00:34:26,960
way with the data um we will of course

841
00:34:31,190 --> 00:34:28,879
you know provide those those fully

842
00:34:36,230 --> 00:34:31,200
produced beautiful images uh to the

843
00:34:41,270 --> 00:34:38,950
great news thank you amber so our next

844
00:34:45,109 --> 00:34:41,280
question comes from connor mcewen on

845
00:34:47,510 --> 00:34:45,119
facebook who asks will the jwst correct

846
00:34:49,430 --> 00:34:47,520
for photons from the sun pushing on the

847
00:34:52,310 --> 00:34:49,440
sun shield scarlen do you have any

848
00:34:56,149 --> 00:34:55,109
uh we will get a lot of solar uh

849
00:34:59,910 --> 00:34:56,159
pressure

850
00:35:01,990 --> 00:34:59,920
sunshield but

851
00:35:05,109 --> 00:35:02,000
as far as the photons and all of that i

852
00:35:08,470 --> 00:35:05,119
think amber would probably be

853
00:35:13,349 --> 00:35:10,710
yeah so um yeah as scarlet mentioned

854
00:35:16,390 --> 00:35:13,359
that solar radiation will push push on

855
00:35:19,190 --> 00:35:16,400
us um so that's you know the sun shield

856
00:35:22,069 --> 00:35:19,200
is essentially a solar sail um so yeah

857
00:35:24,550 --> 00:35:22,079
we will make make small corrections um

858
00:35:26,790 --> 00:35:24,560
during the course of operations to make

859
00:35:28,310 --> 00:35:26,800
sure we sort of offload that momentum

860
00:35:30,069 --> 00:35:28,320
that builds up

861
00:35:31,510 --> 00:35:30,079
from due to solar radiation on the

862
00:35:35,190 --> 00:35:31,520
sunshield yep that's going to be a

863
00:35:36,630 --> 00:35:35,200

regular part of our operations

864
00:35:38,790 --> 00:35:36,640
yeah i think i must understand that

865
00:35:41,349 --> 00:35:38,800
question completely agree with amber on

866
00:35:47,349 --> 00:35:44,550
great thank you so much and on the topic

867
00:35:50,230 --> 00:35:47,359
of new technologies really built for

868
00:35:53,829 --> 00:35:50,240
this telescope we have a question from

869
00:35:55,510 --> 00:35:53,839
brent on twitter who asks what are some

870
00:35:58,069 --> 00:35:55,520
other new technologies

871
00:36:01,109 --> 00:35:58,079
that building the jwst telescope has

872
00:36:02,870 --> 00:36:01,119
created especially transformative tech

873
00:36:04,870 --> 00:36:02,880
that have might have changed our daily

874
00:36:07,190 --> 00:36:04,880
lives so basically he's looking for

875
00:36:09,349 --> 00:36:07,200
spin-offs has any other new technology

876
00:36:11,270 --> 00:36:09,359
been created um

877
00:36:13,430 --> 00:36:11,280
through the building and operation of

878
00:36:15,589 --> 00:36:13,440
web

879
00:36:17,349 --> 00:36:15,599
scarlet or amber whoever wants to go

880
00:36:19,990 --> 00:36:17,359
first that's a great question i'm

881
00:36:21,829 --> 00:36:20,000
curious about

882
00:36:23,270 --> 00:36:21,839
yeah so the the one that comes to mind

883
00:36:25,910 --> 00:36:23,280
that i know of that

884
00:36:28,870 --> 00:36:25,920
i know nasa has has talked about is the

885
00:36:32,470 --> 00:36:28,880
fact that um because these mirrors have

886
00:36:34,470 --> 00:36:32,480
to be aligned so precisely um the shape

887
00:36:36,870 --> 00:36:34,480
of the mirror has to be absolutely

888
00:36:38,790 --> 00:36:36,880

perfect and so that'll happen after this

889
00:36:41,910 --> 00:36:38,800
upcoming three-month mirror alignment

890
00:36:45,589 --> 00:36:41,920
process so if you can imagine if the

891
00:36:48,550 --> 00:36:45,599
whole 22-foot mirror was the size of the

892
00:36:51,030 --> 00:36:48,560
continental us the biggest bump on this

893
00:36:53,910 --> 00:36:51,040
mirror is going to be about an inch or

894
00:36:55,430 --> 00:36:53,920
two okay so it's very very smooth the

895
00:36:58,550 --> 00:36:55,440
surface of the mirror

896
00:37:00,630 --> 00:36:58,560
now it turns out that um confirming that

897
00:37:03,910 --> 00:37:00,640
smoothness and even measuring the

898
00:37:06,630 --> 00:37:03,920
smoothness is really really hard to do

899
00:37:09,349 --> 00:37:06,640
and so just the technology that we had

900
00:37:11,750 --> 00:37:09,359
to develop to measure the smoothness of

901
00:37:14,630 --> 00:37:11,760
the mirror has actually already been

902
00:37:16,550 --> 00:37:14,640
used in the medical field in the field

903
00:37:19,910 --> 00:37:16,560
of ophthalmology

904
00:37:22,230 --> 00:37:19,920
so eye doctors have used this technology

905
00:37:25,109 --> 00:37:22,240
to help measure the shape of the human

906
00:37:26,870 --> 00:37:25,119
eye and this has already gotten benefits

907
00:37:29,510 --> 00:37:26,880
in making um

908
00:37:31,829 --> 00:37:29,520
eye surgery much shorter much more

909
00:37:35,109 --> 00:37:31,839
efficient and much safer so that's one

910
00:37:36,790 --> 00:37:35,119
example of a sort of spin-off technology

911
00:37:39,109 --> 00:37:36,800
that's come from the development of this

912
00:37:42,150 --> 00:37:39,119
telescope that really plays real effects

913
00:37:48,390 --> 00:37:45,430

wow that is really cool thank you amber

914
00:37:50,950 --> 00:37:48,400
and to kind of stick on this topic of

915
00:37:53,670 --> 00:37:50,960
mirrors scarlen we have a question from

916
00:37:55,190 --> 00:37:53,680
brian on youtube who asks

917
00:37:57,589 --> 00:37:55,200
well actually who's looking for more

918
00:37:59,829 --> 00:37:57,599
clarity about where

919
00:38:01,670 --> 00:37:59,839
webb's 18 mirror segments are supposed

920
00:38:04,950 --> 00:38:01,680
to be pointed specifically he's

921
00:38:06,710 --> 00:38:04,960
wondering are all 18 segments pointed in

922
00:38:08,150 --> 00:38:06,720
18 different directions

923
00:38:11,270 --> 00:38:08,160
or

924
00:38:12,550 --> 00:38:11,280
pointed in one direction and aimed at

925
00:38:13,829 --> 00:38:12,560
and targeted

926
00:38:16,470 --> 00:38:13,839
at different

927
00:38:18,950 --> 00:38:16,480
focal points

928
00:38:21,030 --> 00:38:18,960
yes that's a great question so they all

929
00:38:24,710 --> 00:38:21,040
have to be all the 18 segments have to

930
00:38:26,710 --> 00:38:24,720
be aligned um to make that parabolic uh

931
00:38:29,750 --> 00:38:26,720
that iconic picture that you've all seen

932
00:38:32,710 --> 00:38:29,760
it's a bit of a concave uh mirror there

933
00:38:35,109 --> 00:38:32,720
and um basically they all have to be

934
00:38:36,950 --> 00:38:35,119
pointed in the same direction

935
00:38:40,069 --> 00:38:36,960
um the

936
00:38:42,630 --> 00:38:40,079
light is going to be reflected onto the

937
00:38:46,150 --> 00:38:42,640
big giant mirror and then it will be

938
00:38:47,670 --> 00:38:46,160

that will beam into the secondary mirror

939
00:38:50,550 --> 00:38:47,680
of the telescope

940
00:38:52,630 --> 00:38:50,560
which will then uh go back into kind of

941
00:38:53,829 --> 00:38:52,640
like that nose in the middle of that

942
00:38:55,750 --> 00:38:53,839
giant mirror

943
00:38:57,589 --> 00:38:55,760
which holds a tertiary mirror and fine

944
00:38:58,550 --> 00:38:57,599
steering mirror

945
00:39:00,950 --> 00:38:58,560
and so

946
00:39:02,630 --> 00:39:00,960
yes it's that parabolic shape that you

947
00:39:04,870 --> 00:39:02,640
see there

948
00:39:08,550 --> 00:39:04,880
and that's what we need to maintain the

949
00:39:12,390 --> 00:39:08,560
entire time the pointing is done uh

950
00:39:16,790 --> 00:39:14,630
okay great so yes the mirrors are all

951
00:39:17,829 --> 00:39:16,800
actually pointing in the same direction

952
00:39:21,670 --> 00:39:17,839
thank you

953
00:39:24,790 --> 00:39:21,680
and so moving on we have a question from

954
00:39:26,310 --> 00:39:24,800
manuel on twitter who asks can webb's

955
00:39:29,349 --> 00:39:26,320
observations

956
00:39:31,510 --> 00:39:29,359
observation schedule be adjusted in case

957
00:39:32,710 --> 00:39:31,520
a discovery shifts the scientific

958
00:39:33,750 --> 00:39:32,720
priorities

959
00:39:36,150 --> 00:39:33,760
amber

960
00:39:38,790 --> 00:39:36,160
do you have any insight on that

961
00:39:42,230 --> 00:39:38,800
yeah absolutely and in fact that sort of

962
00:39:44,630 --> 00:39:42,240
flexibility in scheduling is is built in

963
00:39:47,910 --> 00:39:44,640

uh and so in astronomers speak those are

964
00:39:49,990 --> 00:39:47,920
called targets of opportunity or to's uh

965
00:39:52,310 --> 00:39:50,000
and so if something super exciting

966
00:39:54,390 --> 00:39:52,320
something sort of short-lived happens uh

967
00:39:56,790 --> 00:39:54,400
in the universe and we want to pause our

968
00:39:59,670 --> 00:39:56,800
observations and point the telescope in

969
00:40:01,670 --> 00:39:59,680
that direction we have that flexibility

970
00:40:03,990 --> 00:40:01,680
built into the schedule to be able to do

971
00:40:06,950 --> 00:40:04,000
that so a good example would be like if

972
00:40:08,710 --> 00:40:06,960
a supernova goes off you know or um or

973
00:40:11,430 --> 00:40:08,720
you know some some other event like that

974
00:40:13,510 --> 00:40:11,440
that happens sort of quickly so yes we

975
00:40:15,430 --> 00:40:13,520
have that capability built in

976
00:40:17,670 --> 00:40:15,440
there are some constraints on that so

977
00:40:19,430 --> 00:40:17,680
you can imagine as the telescope orbits

978
00:40:21,109 --> 00:40:19,440
around the sun

979
00:40:23,430 --> 00:40:21,119
again we sort of talked about it can't

980
00:40:26,230 --> 00:40:23,440
ever look back towards the sun so it can

981
00:40:27,990 --> 00:40:26,240
only see a part of the sky at once and

982
00:40:29,670 --> 00:40:28,000
so if it just so happens that your

983
00:40:31,750 --> 00:40:29,680
object of opportunity is in the wrong

984
00:40:34,390 --> 00:40:31,760
part of the sky we wouldn't be able to

985
00:40:36,710 --> 00:40:34,400
do that but for the most part in general

986
00:40:39,109 --> 00:40:36,720
we do have the flexibility to sort of

987
00:40:41,510 --> 00:40:39,119
pause the scheduled sort of routine

988
00:40:43,030 --> 00:40:41,520

operations to observe things that happen

989
00:40:46,950 --> 00:40:43,040
in the universe

990
00:40:52,870 --> 00:40:49,910
so sticking on kind of these

991
00:40:54,630 --> 00:40:52,880
these shifting in case of a discovery

992
00:40:56,710 --> 00:40:54,640
robert on facebook

993
00:40:58,550 --> 00:40:56,720
asks as part of webb's mission

994
00:41:01,829 --> 00:40:58,560
scientists will be analyzing the

995
00:41:03,990 --> 00:41:01,839
atmospheres of exoplanets on possibly

996
00:41:06,150 --> 00:41:04,000
habitable for possibly habitable

997
00:41:08,390 --> 00:41:06,160
conditions i know that is something a

998
00:41:11,190 --> 00:41:08,400
lot of people are very excited about

999
00:41:13,910 --> 00:41:11,200
with this uh specific mission and so he

1000
00:41:16,390 --> 00:41:13,920
wants to know how will web collect this

1001
00:41:18,790 --> 00:41:16,400
data of these atmospheres and what kind

1002
00:41:22,710 --> 00:41:18,800
of things will scientists be looking for

1003
00:41:29,190 --> 00:41:25,349
so the way that we study exoplanet

1004
00:41:31,910 --> 00:41:29,200
atmospheres is by watching the planet

1005
00:41:33,829 --> 00:41:31,920
transit in front of its star

1006
00:41:35,750 --> 00:41:33,839
and so this is this is how we've been

1007
00:41:38,870 --> 00:41:35,760
able to discover so many of these

1008
00:41:41,829 --> 00:41:38,880
exoplanets in our galaxy is by watching

1009
00:41:44,150 --> 00:41:41,839
a star and watching for the light to dim

1010
00:41:46,630 --> 00:41:44,160
in a periodic way and so that's how we

1011
00:41:49,030 --> 00:41:46,640
know that a planet is orbiting it and so

1012
00:41:50,550 --> 00:41:49,040
you see the simulation on the screen now

1013
00:41:52,710 --> 00:41:50,560

you can sort of see that teeny tiny

1014
00:41:55,430 --> 00:41:52,720
little planet crossing in front of the

1015
00:41:57,910 --> 00:41:55,440
star and you can even get a sense of

1016
00:42:00,069 --> 00:41:57,920
just how hard this is so essentially

1017
00:42:02,790 --> 00:42:00,079
what we're going to be doing is watching

1018
00:42:05,750 --> 00:42:02,800
that planet pass in front of the star

1019
00:42:08,390 --> 00:42:05,760
and then watching the starlight filter

1020
00:42:10,309 --> 00:42:08,400
through that planet's teeny tiny little

1021
00:42:13,270 --> 00:42:10,319
thin atmosphere

1022
00:42:16,230 --> 00:42:13,280
it's really really difficult very

1023
00:42:19,349 --> 00:42:16,240
difficult observations but with jvsd we

1024
00:42:21,990 --> 00:42:19,359
now have new capability to do this um

1025
00:42:24,309 --> 00:42:22,000
better than has ever been done before um

1026
00:42:26,470 --> 00:42:24,319
you know i study i study how stars and

1027
00:42:28,790 --> 00:42:26,480
black holes form in distant galaxies and

1028
00:42:31,109 --> 00:42:28,800
how galaxies change over time so

1029
00:42:34,069 --> 00:42:31,119
exoplanets are pretty far from my own

1030
00:42:36,309 --> 00:42:34,079
personal research but i think that some

1031
00:42:38,550 --> 00:42:36,319
of the exoplanet science that jd rusty

1032
00:42:39,829 --> 00:42:38,560
does is going to be some of the most

1033
00:42:42,790 --> 00:42:39,839
outstanding

1034
00:42:46,309 --> 00:42:42,800
you know surprising uh incredible things

1035
00:42:48,790 --> 00:42:46,319
that jbc is gonna do and it turns out

1036
00:42:50,870 --> 00:42:48,800
that an infrared telescope is perfect

1037
00:42:52,870 --> 00:42:50,880
for these observations because some of

1038
00:42:55,430 --> 00:42:52,880

the things in these atmospheres that we

1039
00:42:56,950 --> 00:42:55,440
really care a lot about um happen to

1040
00:42:59,670 --> 00:42:56,960
fall in the infrared part of the

1041
00:43:02,710 --> 00:42:59,680
spectrum so uh chemical signatures like

1042
00:43:05,670 --> 00:43:02,720
carbon dioxide and methane and water

1043
00:43:07,349 --> 00:43:05,680
vapor all of those that could be sort of

1044
00:43:10,790 --> 00:43:07,359
you know pointing towards the building

1045
00:43:17,270 --> 00:43:14,790
wow i mean that is incredible amber

1046
00:43:18,790 --> 00:43:17,280
thank you so much for just painting that

1047
00:43:21,670 --> 00:43:18,800
picture for us about how this is going

1048
00:43:24,230 --> 00:43:21,680
to happen and i think it's so cool to

1049
00:43:27,430 --> 00:43:24,240
just go back to the fact that

1050
00:43:29,589 --> 00:43:27,440
web is making all these observations at

1051
00:43:32,390 --> 00:43:29,599
a stable orbit at this lagrange point

1052
00:43:34,710 --> 00:43:32,400
too in space and so scarlin

1053
00:43:36,470 --> 00:43:34,720
this whole show we've been talking about

1054
00:43:39,190 --> 00:43:36,480
lagrange 0.2

1055
00:43:45,750 --> 00:43:39,200
i have a question about that how can you

1056
00:43:50,550 --> 00:43:48,790
um so it's actually the reason we chose

1057
00:43:52,950 --> 00:43:50,560
that location

1058
00:43:55,750 --> 00:43:52,960
it's because uh well it was already

1059
00:43:57,270 --> 00:43:55,760
explained in the video uh what lagrange

1060
00:43:58,230 --> 00:43:57,280
point two is but

1061
00:44:02,390 --> 00:43:58,240
um

1062
00:44:05,430 --> 00:44:02,400
the

1063
00:44:07,270 --> 00:44:05,440

telescope is able to float uh much

1064
00:44:10,309 --> 00:44:07,280
easier in that bit

1065
00:44:13,270 --> 00:44:10,319
and we don't have to use much fuel to

1066
00:44:16,870 --> 00:44:13,280
maintain ourselves there

1067
00:44:18,870 --> 00:44:16,880
so that's basically the gist of it

1068
00:44:21,589 --> 00:44:18,880
and you're seeing that in the simulation

1069
00:44:26,309 --> 00:44:23,990
and you see tell the telescope

1070
00:44:29,910 --> 00:44:26,319
orbiting l2

1071
00:44:32,630 --> 00:44:29,920
around orbiting around the sun there

1072
00:44:34,829 --> 00:44:32,640
in this sort of halo orbit not exactly a

1073
00:44:36,390 --> 00:44:34,839
circular orbit more

1074
00:44:38,790 --> 00:44:36,400
halo

1075
00:44:42,069 --> 00:44:38,800
thank you for that and so we have our

1076
00:44:43,910 --> 00:44:42,079
next question from murali on facebook

1077
00:44:46,950 --> 00:44:43,920
who wants to know will james webb

1078
00:44:48,630 --> 00:44:46,960
provide information about the big bang

1079
00:44:51,430 --> 00:44:48,640
amber i think this is a great one for

1080
00:44:56,630 --> 00:44:51,440
you

1081
00:44:57,750 --> 00:44:56,640
know looking back in time um what the

1082
00:45:00,230 --> 00:44:57,760
real

1083
00:45:02,790 --> 00:45:00,240
thing we want to find out with jwst is

1084
00:45:05,430 --> 00:45:02,800
to see the first galaxies that were born

1085
00:45:07,430 --> 00:45:05,440
after the big bang um and so we won't be

1086
00:45:09,670 --> 00:45:07,440
looking back you know so to speak to the

1087
00:45:11,910 --> 00:45:09,680
very quote-unquote moment of the big

1088
00:45:14,470 --> 00:45:11,920

bang but what we're really interested in

1089
00:45:17,670 --> 00:45:14,480
seeing is how what happened in the big

1090
00:45:19,190 --> 00:45:17,680
bang gave rise to those first galaxies

1091
00:45:22,230 --> 00:45:19,200
and that's a part of space that we've

1092
00:45:25,589 --> 00:45:22,240
never seen before so um of course we've

1093
00:45:27,349 --> 00:45:25,599
seen uh images of the sort of the glow

1094
00:45:29,349 --> 00:45:27,359
the remnant of the big bang in the

1095
00:45:31,670 --> 00:45:29,359
cosmic microwave background

1096
00:45:33,670 --> 00:45:31,680
but at that point in time uh there

1097
00:45:35,910 --> 00:45:33,680
weren't there was no stuff right there

1098
00:45:38,470 --> 00:45:35,920
was just radiation uh there was just

1099
00:45:41,750 --> 00:45:38,480
elements and so what we're looking for

1100
00:45:44,790 --> 00:45:41,760
is the the point at which that early

1101
00:45:47,109 --> 00:45:44,800
hydrogen and helium the sort of the

1102
00:45:49,670 --> 00:45:47,119
what was the components of of the big

1103
00:45:51,990 --> 00:45:49,680
bang when that hydrogen and helium first

1104
00:45:54,470 --> 00:45:52,000
started forming the very first stars in

1105
00:45:56,550 --> 00:45:54,480
galaxies the first stuff in the universe

1106
00:45:58,470 --> 00:45:56,560
the first objects and so that's what

1107
00:46:01,910 --> 00:45:58,480
we're going to specifically be looking

1108
00:46:06,309 --> 00:46:01,920
for with jwst is this first epic of

1109
00:46:07,990 --> 00:46:06,319
galaxies that formed after the big bang

1110
00:46:10,230 --> 00:46:08,000
wow and so amber

1111
00:46:12,710 --> 00:46:10,240
to get this right we have never

1112
00:46:15,430 --> 00:46:12,720
done that before have we we have never

1113
00:46:18,230 --> 00:46:15,440

looked that far back

1114
00:46:20,150 --> 00:46:18,240
right yeah so with hubble we've talked a

1115
00:46:22,470 --> 00:46:20,160
little bit about the hubble deep fields

1116
00:46:24,630 --> 00:46:22,480
and with the deepest images we've been

1117
00:46:27,349 --> 00:46:24,640
able to take with hubble we've been able

1118
00:46:29,670 --> 00:46:27,359
to see back pretty far and see some very

1119
00:46:30,790 --> 00:46:29,680
distant galaxies and see those galaxies

1120
00:46:33,349 --> 00:46:30,800
as they were

1121
00:46:35,190 --> 00:46:33,359
in the very distant past so we have been

1122
00:46:37,829 --> 00:46:35,200
able to see very distant galaxies with

1123
00:46:40,230 --> 00:46:37,839
hubble but we sort of come up to the

1124
00:46:43,510 --> 00:46:40,240
edge of what hubble can do we can't see

1125
00:46:45,990 --> 00:46:43,520
any further because these first galaxies

1126
00:46:48,069 --> 00:46:46,000
are emitting their light uh the light

1127
00:46:51,030 --> 00:46:48,079
now is only in the infrared part of the

1128
00:46:53,109 --> 00:46:51,040
spectrum um so even if we had a huge you

1129
00:46:55,030 --> 00:46:53,119
know visible light telescope in space an

1130
00:46:56,950 --> 00:46:55,040
even bigger one we still wouldn't be

1131
00:46:58,950 --> 00:46:56,960
able to see these galaxies because their

1132
00:47:01,670 --> 00:46:58,960
light is now totally in the infrared

1133
00:47:03,750 --> 00:47:01,680
part of the spectrum um and so so yeah

1134
00:47:05,589 --> 00:47:03,760
we'll be able to to see that first epic

1135
00:47:08,950 --> 00:47:05,599
of galaxies that's more distant than

1136
00:47:11,190 --> 00:47:08,960
what we've been able to see with hubble

1137
00:47:13,349 --> 00:47:11,200
that is so exciting thank you thank you

1138
00:47:16,069 --> 00:47:13,359

so much for that and so we have a fun

1139
00:47:19,030 --> 00:47:16,079
question for both of you uh scooby

1140
00:47:21,670 --> 00:47:19,040
arthur on youtube asks what are you

1141
00:47:23,670 --> 00:47:21,680
hoping for for the very first discovery

1142
00:47:28,390 --> 00:47:23,680
scarlet i'll kick it to you and then

1143
00:47:32,710 --> 00:47:30,870
i think for me what's most fascinating

1144
00:47:34,309 --> 00:47:32,720
is to think that now that we're going to

1145
00:47:37,030 --> 00:47:34,319
be able to through

1146
00:47:39,670 --> 00:47:37,040
all of the gas and fog

1147
00:47:42,870 --> 00:47:39,680
in space that we weren't able to before

1148
00:47:45,270 --> 00:47:42,880
mid and infrared um

1149
00:47:48,470 --> 00:47:45,280
that discover things that we didn't know

1150
00:47:51,109 --> 00:47:48,480
existed um so that's super fascinating

1151
00:47:52,710 --> 00:47:51,119
to me of the exoplanets i'm learning

1152
00:47:54,470 --> 00:47:52,720
about

1153
00:47:57,270 --> 00:47:54,480
planets that are made of

1154
00:48:00,470 --> 00:47:57,280
rock like us like earth

1155
00:48:03,190 --> 00:48:00,480
that could have oxygen or

1156
00:48:05,750 --> 00:48:03,200
signs of carbon dioxide

1157
00:48:09,030 --> 00:48:05,760
and us that could help support life

1158
00:48:11,670 --> 00:48:09,040
that's just interesting um

1159
00:48:16,630 --> 00:48:11,680
and know if they're to know about our

1160
00:48:22,630 --> 00:48:19,750
yeah and for me um yeah sort of in a

1161
00:48:24,549 --> 00:48:22,640
similar vein i mean we have all of these

1162
00:48:26,230 --> 00:48:24,559
very specific questions we want to

1163
00:48:28,950 --> 00:48:26,240

answer about the universe right and we

1164
00:48:31,190 --> 00:48:28,960
have this first year of observations

1165
00:48:33,430 --> 00:48:31,200
planned where we hope to start to answer

1166
00:48:36,309 --> 00:48:33,440
some of those questions things like yeah

1167
00:48:37,990 --> 00:48:36,319
how did how did planets and stars form

1168
00:48:39,910 --> 00:48:38,000
and what's going on with some of the

1169
00:48:42,630 --> 00:48:39,920
objects in our solar system and again

1170
00:48:45,349 --> 00:48:42,640
all the way back to finding those first

1171
00:48:47,430 --> 00:48:45,359
galaxies so we have these very specific

1172
00:48:49,750 --> 00:48:47,440
questions that we want to answer but for

1173
00:48:52,630 --> 00:48:49,760
me as a scientist the thing i'm most

1174
00:48:55,030 --> 00:48:52,640
excited about is the discoveries that i

1175
00:48:57,270 --> 00:48:55,040
know we will make that are completely

1176
00:48:59,190 --> 00:48:57,280
unexpected like it's like there are

1177
00:49:01,109 --> 00:48:59,200
these surprises out there lurking in the

1178
00:49:03,430 --> 00:49:01,119
universe things that we've never dreamed

1179
00:49:05,829 --> 00:49:03,440
of and i think we'll find those and i

1180
00:49:08,390 --> 00:49:05,839
think that prospect of finding things

1181
00:49:10,069 --> 00:49:08,400
that completely surprise us that sort of

1182
00:49:12,390 --> 00:49:10,079
change the way we understand the

1183
00:49:15,990 --> 00:49:12,400
universe that is what i'm most excited

1184
00:49:19,910 --> 00:49:18,390
wow thank you both i mean i completely

1185
00:49:21,430 --> 00:49:19,920
agree and also

1186
00:49:23,750 --> 00:49:21,440
i know amber you've done a little bit of

1187
00:49:25,910 --> 00:49:23,760
work with black holes and so just seeing

1188
00:49:27,990 --> 00:49:25,920

what this telescope even reveals about

1189
00:49:29,829 --> 00:49:28,000
those is going to be incredible so so

1190
00:49:30,870 --> 00:49:29,839
much great science to come for webb

1191
00:49:33,190 --> 00:49:30,880
right now

1192
00:49:33,990 --> 00:49:33,200
so for scarlet i've got a question for

1193
00:49:36,390 --> 00:49:34,000
you

1194
00:49:39,910 --> 00:49:36,400
from afgeek on twitter

1195
00:49:42,710 --> 00:49:39,920
who asks how excited does an aerospace

1196
00:49:47,990 --> 00:49:42,720
engineer get about the astronomical

1197
00:49:51,589 --> 00:49:49,589
and i can repeat that as well if you

1198
00:49:54,950 --> 00:49:51,599
need it super excited even though you

1199
00:49:59,510 --> 00:49:57,190
it's i remember during the deployment

1200
00:50:01,430 --> 00:49:59,520
phase i was on the edge of my seat it

1201
00:50:02,790 --> 00:50:01,440
was like watching you know the super

1202
00:50:04,230 --> 00:50:02,800
bowl for me

1203
00:50:07,270 --> 00:50:04,240
um

1204
00:50:09,109 --> 00:50:07,280
and pop champagne while i was in the

1205
00:50:11,030 --> 00:50:09,119
control center but obviously that's not

1206
00:50:13,030 --> 00:50:11,040
a good idea

1207
00:50:15,109 --> 00:50:13,040
but definitely when i got home it was a

1208
00:50:17,270 --> 00:50:15,119
big celebration um

1209
00:50:19,349 --> 00:50:17,280
i'm really over the moon about how

1210
00:50:20,950 --> 00:50:19,359
amazing everything has been going up to

1211
00:50:24,069 --> 00:50:20,960
this point and i'm so excited for the

1212
00:50:29,270 --> 00:50:25,109
nice and

1213
00:50:33,270 --> 00:50:29,280

amber how excited does an astronomer get

1214
00:50:38,230 --> 00:50:36,069
yeah well i mean we're obviously excited

1215
00:50:40,870 --> 00:50:38,240
about the science of course all of us

1216
00:50:43,109 --> 00:50:40,880
astronomers are but for me one of the

1217
00:50:45,510 --> 00:50:43,119
coolest things about working at nasa is

1218
00:50:47,910 --> 00:50:45,520
that we do work alongside these

1219
00:50:51,030 --> 00:50:47,920
brilliant engineers that have built this

1220
00:50:52,870 --> 00:50:51,040
awesome machine that is going to i think

1221
00:50:55,510 --> 00:50:52,880
change the way that we understand the

1222
00:50:57,670 --> 00:50:55,520
universe and um just to be a part of

1223
00:51:00,309 --> 00:50:57,680
that to be uh you know to be able to

1224
00:51:02,790 --> 00:51:00,319
walk across campus and see the telescope

1225
00:51:05,349 --> 00:51:02,800
being built a few years ago really gave

1226
00:51:07,510 --> 00:51:05,359
me a much better understanding again as

1227
00:51:08,390 --> 00:51:07,520
a scientist it gave me a better

1228
00:51:09,109 --> 00:51:08,400
understanding

1229
00:51:11,190 --> 00:51:09,119
of

1230
00:51:13,670 --> 00:51:11,200
just what goes into engineering to

1231
00:51:15,670 --> 00:51:13,680
building these types of things it's

1232
00:51:17,750 --> 00:51:15,680
absolutely incredible you know i think

1233
00:51:21,190 --> 00:51:17,760
this is a this is a moment in our

1234
00:51:23,349 --> 00:51:21,200
history uh as humans that we can just as

1235
00:51:25,670 --> 00:51:23,359
you know as a society as

1236
00:51:28,069 --> 00:51:25,680
as a species be so proud of because

1237
00:51:30,470 --> 00:51:28,079
we've built this amazing beautiful

1238
00:51:32,309 --> 00:51:30,480

machine uh that is going to transform

1239
00:51:35,430 --> 00:51:32,319
our understanding of the universe and i

1240
00:51:39,910 --> 00:51:37,990
so well put thank you both for that uh

1241
00:51:41,750 --> 00:51:39,920
answer and so

1242
00:51:44,230 --> 00:51:41,760
scarlet i have another follow-up for you

1243
00:51:47,270 --> 00:51:44,240
glitchedrobot on twitter asks what can

1244
00:51:49,750 --> 00:51:47,280
you tell us about jwst's secondary

1245
00:51:53,270 --> 00:51:49,760
mirror is it the same material as the

1246
00:51:58,309 --> 00:51:55,910
uh so it is another gold mirror um and

1247
00:52:00,109 --> 00:51:58,319
it's con it's the convex

1248
00:52:02,829 --> 00:52:00,119
very mirror about

1249
00:52:06,230 --> 00:52:02,839
2.40 diameter i

1250
00:52:08,870 --> 00:52:06,240
believe good question

1251
00:52:11,990 --> 00:52:08,880
yeah thank you for that glitched robot

1252
00:52:14,390 --> 00:52:12,000
so moving on amber we've got a question

1253
00:52:17,829 --> 00:52:14,400
from an 8th grade student who wants to

1254
00:52:20,470 --> 00:52:17,839
know if jwst will be used to find or

1255
00:52:24,150 --> 00:52:20,480
identify large objects in the coupler

1256
00:52:28,630 --> 00:52:27,190
absolutely so um that part of the outer

1257
00:52:30,470 --> 00:52:28,640
solar system

1258
00:52:33,829 --> 00:52:30,480
is something we're definitely planning

1259
00:52:36,069 --> 00:52:33,839
to uh to use jbst to study objects and

1260
00:52:38,549 --> 00:52:36,079
to look for objects there so

1261
00:52:40,950 --> 00:52:38,559
yep like i said the the whole solar

1262
00:52:43,990 --> 00:52:40,960
system basically from mars on out is

1263
00:52:45,430 --> 00:52:44,000

fair game and so we absolutely will be

1264
00:52:48,470 --> 00:52:45,440
looking for objects in the outer solar

1265
00:52:52,230 --> 00:52:48,480
system with this telescope

1266
00:52:54,710 --> 00:52:52,240
wow i mean thrilled for what's to come

1267
00:52:57,589 --> 00:52:54,720
and unfortunately that is all the time

1268
00:52:59,670 --> 00:52:57,599
that we have for today but amber scarlet

1269
00:53:01,430 --> 00:52:59,680
thank you both so much for your time

1270
00:53:03,349 --> 00:53:01,440
today it was so great to hear your

1271
00:53:06,630 --> 00:53:03,359
insight on this mission and we really

1272
00:53:10,630 --> 00:53:08,309
thank you it was really an honor to

1273
00:53:13,109 --> 00:53:10,640
share with you all

1274
00:53:15,589 --> 00:53:13,119
yeah thanks so much this has been fun so

1275
00:53:17,910 --> 00:53:15,599
exciting

1276
00:53:20,470 --> 00:53:17,920
and a big thank you to all of you who

1277
00:53:22,710 --> 00:53:20,480
joined and asked your question today

1278
00:53:24,710 --> 00:53:22,720
make sure to stick with us as web gears

1279
00:53:27,270 --> 00:53:24,720
up to unfold the universe and start

1280
00:53:29,589 --> 00:53:27,280
sending back science and data

1281
00:53:32,549 --> 00:53:29,599
visit go.nasa.gov

1282
00:53:34,390 --> 00:53:32,559
forward slash where is web to keep up

1283
00:53:36,630 --> 00:53:34,400
with the telescope's milestones the

1284
00:53:39,270 --> 00:53:36,640
observatory's temperature and its

1285
00:53:41,990 --> 00:53:39,280
location in space the team will also be

1286
00:53:44,230 --> 00:53:42,000
posting regular updates to the at nasa

1287
00:53:46,870 --> 00:53:44,240
web social media accounts that includes

1288
00:53:49,349 --> 00:53:46,880

twitter facebook and instagram

1289
00:53:52,309 --> 00:53:49,359
we will be back to answer your questions

1290
00:53:59,060 --> 00:53:52,319
live on this show once web releases its