
EUROPA CLIPPER:
What's So Cool About Jupiter's Icy Moon?
NASA
Jet Propulsion Laboratory
California Institute of Technology

1
00:00:06,110 --> 00:00:04,070
welcome to the spacecraft assembly

2
00:00:08,570 --> 00:00:06,120
facility at NASA's jet propulsion

3
00:00:10,970 --> 00:00:08,580
laboratory behind us is the clean room

4
00:00:13,970 --> 00:00:10,980
where you can see NASA's Europa Clipper

5
00:00:16,310 --> 00:00:13,980
spacecraft Europa is the name of one of

6
00:00:18,529 --> 00:00:16,320
Jupiter's moons it's just a little

7
00:00:20,689 --> 00:00:18,539
smaller than Earth's moon but previous

8
00:00:23,330 --> 00:00:20,699
missions have shown strong evidence of

9
00:00:26,210 --> 00:00:23,340
an ocean of liquid water beneath its icy

10
00:00:28,790 --> 00:00:26,220
crust and the Europa Clipper is going to

11
00:00:31,370 --> 00:00:28,800
investigate so let's talk to some

12
00:00:34,190 --> 00:00:31,380
experts about the mission joining us

13
00:00:35,750 --> 00:00:34,200

today is Europa project staff scientist

14
00:00:38,389 --> 00:00:35,760
Cynthia Phillips

15
00:00:40,430 --> 00:00:38,399
and Europa Clipper project systems

16
00:00:43,250 --> 00:00:40,440
engineer Jennifer Dooley thanks for

17
00:00:45,410 --> 00:00:43,260
joining us they'll be talking to us for

18
00:00:47,090 --> 00:00:45,420
the next half hour or so answering your

19
00:00:49,310 --> 00:00:47,100
questions so if you have a question

20
00:00:52,490 --> 00:00:49,320
you'd like to ask drop in the chat below

21
00:00:54,410 --> 00:00:52,500
and we'll get to as many as we can so to

22
00:00:56,750 --> 00:00:54,420
get us started Cynthia could you tell us

23
00:00:59,270 --> 00:00:56,760
more about Europa and why scientists

24
00:01:00,650 --> 00:00:59,280
want to investigate this area sure Colin

25
00:01:03,290 --> 00:01:00,660
and thanks so much and thanks to our

26
00:01:05,570 --> 00:01:03,300
audience for joining us today so as

27
00:01:07,789 --> 00:01:05,580
Raquel said Europa is a moon of Jupiter

28
00:01:09,609 --> 00:01:07,799
it's about the same size as Earth's moon

29
00:01:11,810 --> 00:01:09,619
but it looks completely different

30
00:01:13,910 --> 00:01:11,820
instead of having a surface that's

31
00:01:16,429 --> 00:01:13,920
covered with Rock and craters like our

32
00:01:19,190 --> 00:01:16,439
own Moon the surface of Europa instead

33
00:01:20,990 --> 00:01:19,200
is covered with ice has a thick layer of

34
00:01:23,450 --> 00:01:21,000
ice at the surface that's filled with

35
00:01:26,270 --> 00:01:23,460
cracks and ridges and scientists are

36
00:01:29,330 --> 00:01:26,280
pretty sure that under that ice layer is

37
00:01:31,190 --> 00:01:29,340
a global ocean layer of liquid water and

38
00:01:33,649 --> 00:01:31,200

this ocean could have more water than

39
00:01:35,450 --> 00:01:33,659
all of Earth's oceans combined and so

40
00:01:37,609 --> 00:01:35,460
because of that scientists think that

41
00:01:39,530 --> 00:01:37,619
Europa is one of the best places to look

42
00:01:42,109 --> 00:01:39,540
for life in our solar system beyond the

43
00:01:44,510 --> 00:01:42,119
Earth and the Europa Clipper spacecraft

44
00:01:47,270 --> 00:01:44,520
is going to take the first step in going

45
00:01:49,730 --> 00:01:47,280
to Europa to assess the habitability of

46
00:01:51,710 --> 00:01:49,740
Europa so Europa Clipper isn't going to

47
00:01:53,270 --> 00:01:51,720
look for Life directly what it's going

48
00:01:55,910 --> 00:01:53,280
to do is it's going to look for places

49
00:01:58,730 --> 00:01:55,920
below europa's surface that we think

50
00:02:01,069 --> 00:01:58,740
could support Life as We Know It

51
00:02:03,830 --> 00:02:01,079
yes it sounds like an exciting Mission

52
00:02:05,590 --> 00:02:03,840
and Jennifer can you tell us more about

53
00:02:09,109 --> 00:02:05,600
the spacecraft that we see behind us

54
00:02:11,809 --> 00:02:09,119
absolutely so right behind me you can

55
00:02:16,369 --> 00:02:11,819
see the propulsion module this is the

56
00:02:20,150 --> 00:02:16,379
main structure for the spacecraft and if

57
00:02:22,070 --> 00:02:20,160
you can see the the red covers those are

58
00:02:23,930 --> 00:02:22,080
protecting some of our propulsion

59
00:02:28,970 --> 00:02:23,940
components

60
00:02:30,250 --> 00:02:28,980
um we also have a vault which is a large

61
00:02:32,990 --> 00:02:30,260
container

62
00:02:35,030 --> 00:02:33,000
that provides shielding for some of the

63
00:02:36,949 --> 00:02:35,040

electronics and other sensitive

64
00:02:39,729 --> 00:02:36,959
components that help shield from the

65
00:02:43,550 --> 00:02:39,739
radiation environment and then

66
00:02:46,550 --> 00:02:43,560
we after we have assembled all of that

67
00:02:51,470 --> 00:02:46,560
that Vault goes on top of the propulsion

68
00:02:53,809 --> 00:02:51,480
module and as we continue with the

69
00:02:56,270 --> 00:02:53,819
Assembly of the spacecraft eventually

70
00:02:58,850 --> 00:02:56,280
will bring in the solar arrays and mount

71
00:03:01,009 --> 00:02:58,860
those to the propulsion module as well

72
00:03:02,869 --> 00:03:01,019
and so you can see you know if you saw

73
00:03:05,030 --> 00:03:02,879
the the image that was projected a

74
00:03:07,670 --> 00:03:05,040
little while ago the scale of that right

75
00:03:09,890 --> 00:03:07,680
this is a very large spacecraft

76
00:03:11,570 --> 00:03:09,900
you can really see it behind us and

77
00:03:13,910 --> 00:03:11,580
there is some action going on behind us

78
00:03:15,110 --> 00:03:13,920
can you let us know maybe what is going

79
00:03:18,589 --> 00:03:15,120
on right now

80
00:03:21,229 --> 00:03:18,599
well uh so right now we've got the crane

81
00:03:23,390 --> 00:03:21,239
that the team is using to uh start to

82
00:03:25,550 --> 00:03:23,400
move some components and and check out

83
00:03:27,890 --> 00:03:25,560
the lifting fixtures that we have and

84
00:03:32,149 --> 00:03:27,900
slings to ensure everything safe before

85
00:03:34,190 --> 00:03:32,159
we do any move of Hardware we also have

86
00:03:38,570 --> 00:03:34,200
um work going on which is a little bit

87
00:03:40,070 --> 00:03:38,580
less visible but over on the Vault we

88
00:03:42,050 --> 00:03:40,080

have

89
00:03:44,690 --> 00:03:42,060
um the uh some several of the

90
00:03:45,770 --> 00:03:44,700
instruments that have been installed and

91
00:03:47,330 --> 00:03:45,780
are starting to go through their

92
00:03:50,750 --> 00:03:47,340
functional testing and today we're

93
00:03:52,130 --> 00:03:50,760
testing the ultraviolet spectrograph and

94
00:03:55,670 --> 00:03:52,140
the tests that are going on today are

95
00:03:58,550 --> 00:03:55,680
going to be checks of the thermal uh

96
00:04:01,670 --> 00:03:58,560
functional so so heaters and temperature

97
00:04:04,789 --> 00:04:01,680
sensors they're going to be moving files

98
00:04:06,289 --> 00:04:04,799
to the instrument to ensure that if we

99
00:04:09,289 --> 00:04:06,299
need to we're able to update the

100
00:04:12,410 --> 00:04:09,299
software while we're in flight and then

101
00:04:13,850 --> 00:04:12,420
they've also rotated the Vault from

102
00:04:16,729 --> 00:04:13,860
where it was yesterday so that they'll

103
00:04:19,430 --> 00:04:16,739
be able to check the deployment of the

104
00:04:21,349 --> 00:04:19,440
cover and the door so that's all going

105
00:04:23,510 --> 00:04:21,359
on today

106
00:04:25,249 --> 00:04:23,520
that's happening right now and we're

107
00:04:27,350 --> 00:04:25,259
seeing it live right now and for

108
00:04:29,090 --> 00:04:27,360
everyone just joining we are in a space

109
00:04:30,710 --> 00:04:29,100
where the Europa Clipper spacecraft is

110
00:04:33,830 --> 00:04:30,720
being assembled ahead of its schedule

111
00:04:35,450 --> 00:04:33,840
2024 launch so over the next several

112
00:04:37,550 --> 00:04:35,460
months you can keep track of its

113
00:04:39,830 --> 00:04:37,560

progress with our live cam on our

114
00:04:41,810 --> 00:04:39,840
YouTube channel and let's actually take

115
00:04:44,030 --> 00:04:41,820
a look at that feed right now you can

116
00:04:47,270 --> 00:04:44,040
get a quick preview of it you know this

117
00:04:49,070 --> 00:04:47,280
feed runs Live 24 7. so be sure to

118
00:04:52,129 --> 00:04:49,080
bookmark it or save it so you can check

119
00:04:53,990 --> 00:04:52,139
it out whenever you have free time and I

120
00:04:56,270 --> 00:04:54,000
have another question for you Cynthia

121
00:04:58,010 --> 00:04:56,280
you know Europa we're about to get a

122
00:05:01,490 --> 00:04:58,020
close look at Europa with a different

123
00:05:04,070 --> 00:05:01,500
Mission soon correct that's right so the

124
00:05:05,930 --> 00:05:04,080
last time that we saw Europa was up

125
00:05:08,390 --> 00:05:05,940
close was with the Galileo spacecraft

126
00:05:11,270 --> 00:05:08,400
this spacecraft traveled to the Jupiter

127
00:05:13,730 --> 00:05:11,280
system in the late 1990s and it orbited

128
00:05:16,189 --> 00:05:13,740
Jupiter with multiple close flybys of

129
00:05:20,749 --> 00:05:16,199
Europa and the other large satellites

130
00:05:23,570 --> 00:05:20,759
from 1995 until about 2003 but since

131
00:05:25,370 --> 00:05:23,580
2003 we haven't had any close-up

132
00:05:27,890 --> 00:05:25,380
pictures that have been taken of Europa

133
00:05:30,290 --> 00:05:27,900
we've had a few distant pictures that

134
00:05:32,629 --> 00:05:30,300
were taken by other spacecraft as they

135
00:05:34,790 --> 00:05:32,639
passed by the Jupiter system on their

136
00:05:36,710 --> 00:05:34,800
way to the far reaches the outer solar

137
00:05:38,210 --> 00:05:36,720
system such as the Cassini spacecraft

138
00:05:41,029 --> 00:05:38,220

and then later on the New Horizon

139
00:05:43,490 --> 00:05:41,039
spacecraft but we're really excited

140
00:05:46,670 --> 00:05:43,500
because tomorrow morning our time here

141
00:05:48,710 --> 00:05:46,680
in California the Juno spacecraft which

142
00:05:50,810 --> 00:05:48,720
has been in orbit around Jupiter for the

143
00:05:54,230 --> 00:05:50,820
last couple years Juno is going to have

144
00:05:56,570 --> 00:05:54,240
its first close flyby of Europa and so

145
00:05:58,610 --> 00:05:56,580
we're really excited to get to see a few

146
00:06:00,770 --> 00:05:58,620
new pictures of Europa for the first

147
00:06:02,870 --> 00:06:00,780
time in almost 20 years

148
00:06:05,450 --> 00:06:02,880
that's fantastic I think two decades now

149
00:06:08,450 --> 00:06:05,460
will people at home and watching be able

150
00:06:11,810 --> 00:06:08,460
to see it so you won't be able to see

151
00:06:13,370 --> 00:06:11,820
the fly by yourself but the pictures and

152
00:06:15,350 --> 00:06:13,380
the other observations that will be

153
00:06:17,710 --> 00:06:15,360
taken by the spacecraft will be

154
00:06:20,270 --> 00:06:17,720
downloaded tomorrow so this is Thursday

155
00:06:22,189 --> 00:06:20,280
and we expect to see the first picture

156
00:06:23,990 --> 00:06:22,199
is released within the first day or two

157
00:06:25,790 --> 00:06:24,000
and then the scientists will take a

158
00:06:27,350 --> 00:06:25,800
little bit longer to process all of the

159
00:06:30,050 --> 00:06:27,360
information from some of the other

160
00:06:31,550 --> 00:06:30,060
instruments on the Juno spacecraft and

161
00:06:33,050 --> 00:06:31,560
so we should expect to see more results

162
00:06:35,749 --> 00:06:33,060
from that come out

163
00:06:37,610 --> 00:06:35,759

very cool and what about Jupiter like

164
00:06:40,129 --> 00:06:37,620
could you see it at home right now since

165
00:06:41,629 --> 00:06:40,139
it's so close that's right so this is a

166
00:06:43,909 --> 00:06:41,639
really exciting time actually because

167
00:06:47,090 --> 00:06:43,919
Jupiter is at what's called opposition

168
00:06:49,189 --> 00:06:47,100
and opposition is when the alignment of

169
00:06:51,230 --> 00:06:49,199
the planets is such that Jupiter is at

170
00:06:53,330 --> 00:06:51,240
about as close as it ever gets to the

171
00:06:55,490 --> 00:06:53,340
Earth and so this means that Jupiter

172
00:06:57,770 --> 00:06:55,500
will appear like a really really bright

173
00:06:59,469 --> 00:06:57,780
scar in the night sky and you can

174
00:07:01,730 --> 00:06:59,479
actually go out and see Jupiter yourself

175
00:07:03,770 --> 00:07:01,740
with just your eyeball if you look up

176
00:07:06,529 --> 00:07:03,780
you'll see this really bright star but

177
00:07:08,689 --> 00:07:06,539
with a cell phone with night mode or

178
00:07:11,330 --> 00:07:08,699
with a just a simple pair of binoculars

179
00:07:13,790 --> 00:07:11,340
if you look up you can actually see some

180
00:07:16,850 --> 00:07:13,800
of the moons of Jupiter so you could put

181
00:07:18,710 --> 00:07:16,860
your eyeballs on Europa tomorrow

182
00:07:20,629 --> 00:07:18,720
at about the same time that the Juno

183
00:07:22,309 --> 00:07:20,639
spacecraft is going to be flying past it

184
00:07:24,409 --> 00:07:22,319
in the Jupiter system and I just think

185
00:07:25,850 --> 00:07:24,419
that's so cool very much so I really

186
00:07:27,770 --> 00:07:25,860
want to get a pair of binoculars right

187
00:07:29,390 --> 00:07:27,780
now that you mentioned it so let's kind

188
00:07:33,110 --> 00:07:29,400

of bring it back to the room right now

189
00:07:34,430 --> 00:07:33,120
and Jennifer the Clipper the real book

190
00:07:36,170 --> 00:07:34,440
Clipper is behind us can you tell us

191
00:07:37,790 --> 00:07:36,180
about some of the spacecraft instruments

192
00:07:41,689 --> 00:07:37,800
that we can see right now in our view

193
00:07:43,330 --> 00:07:41,699
yeah absolutely so um we also we we

194
00:07:46,010 --> 00:07:43,340
mentioned uh the ultraviolet

195
00:07:48,830 --> 00:07:46,020
spectrograph earlier so that is an

196
00:07:51,950 --> 00:07:48,840
instrument that is going to take a

197
00:07:54,050 --> 00:07:51,960
spectrum in the ultraviolet range and

198
00:07:56,150 --> 00:07:54,060
that gives us a fingerprint essentially

199
00:07:59,210 --> 00:07:56,160
lets us look for things like oxygen or

200
00:08:00,770 --> 00:07:59,220
carbon dioxide or simple Organics so

201
00:08:02,689 --> 00:08:00,780
that's a really exciting instrument it's

202
00:08:05,510 --> 00:08:02,699
also one of the instruments that we

203
00:08:08,930 --> 00:08:05,520
would if we were lucky enough to come

204
00:08:10,430 --> 00:08:08,940
across a plume we would want to

205
00:08:13,070 --> 00:08:10,440
interrogate it with that that would let

206
00:08:14,629 --> 00:08:13,080
us look at some of the material coming

207
00:08:16,550 --> 00:08:14,639
directly from the ocean which is of

208
00:08:18,650 --> 00:08:16,560
course the environment that we're very

209
00:08:21,770 --> 00:08:18,660
in interested in understanding its

210
00:08:23,689 --> 00:08:21,780
habitability other instruments on the

211
00:08:26,990 --> 00:08:23,699
spacecraft right now very close to where

212
00:08:28,790 --> 00:08:27,000
the UVS is include our thermal imager

213
00:08:30,650 --> 00:08:28,800

which is going to let us look very

214
00:08:32,630 --> 00:08:30,660
carefully for

215
00:08:36,310 --> 00:08:32,640
little temperature variations that might

216
00:08:39,409 --> 00:08:36,320
indicate thinner ice or younger material

217
00:08:42,769 --> 00:08:39,419
it will also let us interrogate the

218
00:08:46,370 --> 00:08:42,779
surface so the the you know is it hard

219
00:08:49,250 --> 00:08:46,380
packed solid ice is it more fluffy

220
00:08:51,850 --> 00:08:49,260
grainy type of material and that's a

221
00:08:54,889 --> 00:08:51,860
sort of an interesting

222
00:08:57,410 --> 00:08:54,899
feature of it and and could feed into

223
00:08:59,750 --> 00:08:57,420
decisions for later about where you

224
00:09:01,850 --> 00:08:59,760
might want to go to to do our next kinds

225
00:09:03,949 --> 00:09:01,860
of missions that go to Europa and then

226
00:09:05,750 --> 00:09:03,959
another one is the wide angle camera and

227
00:09:07,610 --> 00:09:05,760
that's going to be just a Workhorse

228
00:09:10,190 --> 00:09:07,620
right we want to map and get color

229
00:09:12,350 --> 00:09:10,200
images of as much of Europa as we can

230
00:09:15,110 --> 00:09:12,360
and that and that I think that together

231
00:09:16,790 --> 00:09:15,120
with its narrow angle camera sibling is

232
00:09:18,710 --> 00:09:16,800
going to get us over 90 percent of the

233
00:09:20,870 --> 00:09:18,720
surface wow thanks for that breakdown

234
00:09:22,370 --> 00:09:20,880
now if you're tuning in we're about to

235
00:09:24,650 --> 00:09:22,380
get to your questions we'll answer as

236
00:09:26,690 --> 00:09:24,660
many as we can so please drop them in

237
00:09:28,910 --> 00:09:26,700
the chat below joining us right now is

238
00:09:30,590 --> 00:09:28,920

Europa project staff scientist Cynthia

239
00:09:33,110 --> 00:09:30,600
Phillips and Europa Clipper product

240
00:09:35,150 --> 00:09:33,120
project systems engineer Jennifer Dooley

241
00:09:37,610 --> 00:09:35,160
and I actually want to talk about your

242
00:09:40,730 --> 00:09:37,620
roles right now so Jennifer can you tell

243
00:09:43,009 --> 00:09:40,740
us more about what your role entails so

244
00:09:44,930 --> 00:09:43,019
my responsibility is ensuring the

245
00:09:46,550 --> 00:09:44,940
technical Integrity of the mission and

246
00:09:48,590 --> 00:09:46,560
that the mission accomplishes its

247
00:09:51,230 --> 00:09:48,600
essential function which is getting all

248
00:09:53,990 --> 00:09:51,240
of the great observations to pass to our

249
00:09:56,389 --> 00:09:54,000
science team and really a big part of

250
00:09:57,530 --> 00:09:56,399
that is you know we we can talk about

251
00:10:00,230 --> 00:09:57,540
the different instruments and the

252
00:10:01,850 --> 00:10:00,240
different subsystems and we design up

253
00:10:04,250 --> 00:10:01,860
front we give everybody their their

254
00:10:06,050 --> 00:10:04,260
marching orders what to make and then it

255
00:10:07,670 --> 00:10:06,060
comes in together and one of our jobs is

256
00:10:10,430 --> 00:10:07,680
to make sure that all of those pieces

257
00:10:12,650 --> 00:10:10,440
play well together and again we're able

258
00:10:14,449 --> 00:10:12,660
to accomplish the the ultimate function

259
00:10:17,210 --> 00:10:14,459
right that we haven't lost the the

260
00:10:19,310 --> 00:10:17,220
forest for the trees thanks Jennifer and

261
00:10:21,590 --> 00:10:19,320
now Cynthia can you tell us how you are

262
00:10:23,210 --> 00:10:21,600
part of this Mission as well sure so I

263
00:10:26,509 --> 00:10:23,220

work as part of the project science

264
00:10:28,850 --> 00:10:26,519
group and basically on Europa Clipper we

265
00:10:30,889 --> 00:10:28,860
have one project scientist who's kind of

266
00:10:32,570 --> 00:10:30,899
the one who's in charge of making sure

267
00:10:35,750 --> 00:10:32,580
that all of Europa Clippers complex

268
00:10:37,370 --> 00:10:35,760
instruments work together to accomplish

269
00:10:38,870 --> 00:10:37,380
all of the science goals that we have

270
00:10:40,670 --> 00:10:38,880
the goals and objectives for this

271
00:10:42,170 --> 00:10:40,680
Mission and as part of the project

272
00:10:44,389 --> 00:10:42,180
science group so we have our project

273
00:10:46,190 --> 00:10:44,399
scientist Bob papillardo and then we

274
00:10:47,990 --> 00:10:46,200
have the principal investigator of each

275
00:10:50,090 --> 00:10:48,000
of the instrument teams that we talked

276
00:10:51,470 --> 00:10:50,100
about and then there's over a hundred

277
00:10:53,449 --> 00:10:51,480
scientists who are part of those

278
00:10:54,949 --> 00:10:53,459
different instrument teams who work as

279
00:10:56,870 --> 00:10:54,959
part of the whole science team for this

280
00:10:59,030 --> 00:10:56,880
Mission and so as part of the the

281
00:11:00,410 --> 00:10:59,040
project science team I basically just

282
00:11:02,810 --> 00:11:00,420
helped to make sure that everything is

283
00:11:04,190 --> 00:11:02,820
coordinated between the the folks who

284
00:11:06,050 --> 00:11:04,200
are building our spacecraft the folks

285
00:11:07,490 --> 00:11:06,060
who are building our instruments and

286
00:11:09,110 --> 00:11:07,500
then the scientists who eventually are

287
00:11:11,870 --> 00:11:09,120
going to make the plans for how we use

288
00:11:13,310 --> 00:11:11,880

those instruments to observe Europa okay

289
00:11:15,110 --> 00:11:13,320
thank you thank you both for letting us

290
00:11:16,730 --> 00:11:15,120
know your rules and now it's time to get

291
00:11:19,850 --> 00:11:16,740
to viewer question I think that was

292
00:11:22,550 --> 00:11:19,860
really helpful so Colin on Twitter asks

293
00:11:24,530 --> 00:11:22,560
how will this upcoming Juno flyby help

294
00:11:27,590 --> 00:11:24,540
the Europa Clipper team

295
00:11:29,870 --> 00:11:27,600
that's a great question so when the Juno

296
00:11:32,090 --> 00:11:29,880
spacecraft goes by you know as I said we

297
00:11:34,610 --> 00:11:32,100
haven't seen europa's surface for almost

298
00:11:35,990 --> 00:11:34,620
20 years so you know we know Europe is

299
00:11:38,090 --> 00:11:36,000
still there right it hasn't gone

300
00:11:39,350 --> 00:11:38,100
anywhere but it's possible that

301
00:11:41,509 --> 00:11:39,360
something could look different on the

302
00:11:43,910 --> 00:11:41,519
surface and one of the things we've been

303
00:11:45,650 --> 00:11:43,920
really excited about that's happened in

304
00:11:47,810 --> 00:11:45,660
those 20 years since the Galileo

305
00:11:49,250 --> 00:11:47,820
spacecraft ended its mission is that we

306
00:11:52,490 --> 00:11:49,260
started seeing evidence that maybe

307
00:11:53,750 --> 00:11:52,500
there's plumes erupting from Europa we

308
00:11:55,790 --> 00:11:53,760
don't know for sure that they're there

309
00:11:58,130 --> 00:11:55,800
but we've seen some kind of tantalizing

310
00:12:00,590 --> 00:11:58,140
evidence both from re-analysis of some

311
00:12:02,690 --> 00:12:00,600
of our old spacecraft data but also from

312
00:12:03,949 --> 00:12:02,700
observations taken by earth-based

313
00:12:06,889 --> 00:12:03,959

observatories like the Hubble Space

314
00:12:08,509 --> 00:12:06,899
Telescope and so one of the things that

315
00:12:10,550 --> 00:12:08,519
Juno will be able to do is to see

316
00:12:12,590 --> 00:12:10,560
whether is there any evidence that

317
00:12:14,750 --> 00:12:12,600
something's changed on Europa is there

318
00:12:16,910 --> 00:12:14,760
something erupting from Europa or even

319
00:12:18,889 --> 00:12:16,920
is there a place on Europa that looks

320
00:12:21,110 --> 00:12:18,899
warmer than we would expect it to look

321
00:12:22,850 --> 00:12:21,120
and so we're going to be looking at the

322
00:12:25,610 --> 00:12:22,860
data from the Juno flyby really

323
00:12:27,829 --> 00:12:25,620
carefully to help us plan for what we

324
00:12:30,110 --> 00:12:27,839
might see with Europa Clipper be really

325
00:12:32,509 --> 00:12:30,120
excited to see those images coming very

326
00:12:35,449 --> 00:12:32,519
very soon so this is a question for

327
00:12:37,009 --> 00:12:35,459
Jennifer David on Twitter asks what does

328
00:12:39,590 --> 00:12:37,019
the future hold for the second

329
00:12:41,449 --> 00:12:39,600
spacecraft to the left of you on the

330
00:12:44,449 --> 00:12:41,459
clean room floor so he must have seen it

331
00:12:46,009 --> 00:12:44,459
when there was a wider view of right so

332
00:12:48,650 --> 00:12:46,019
I don't think you can see it now but

333
00:12:50,090 --> 00:12:48,660
what what you would see if you were

334
00:12:53,990 --> 00:12:50,100
standing where I am in the viewing

335
00:12:57,470 --> 00:12:54,000
Gallery uh behind me is essentially a

336
00:12:59,030 --> 00:12:57,480
clone of the propulsion module that we

337
00:13:01,069 --> 00:12:59,040
were kind of looking at earlier that has

338
00:13:02,750 --> 00:13:01,079

the the red shields you know at

339
00:13:04,850 --> 00:13:02,760
different places around minus those

340
00:13:08,449 --> 00:13:04,860
Shields and essentially the purpose of

341
00:13:10,850 --> 00:13:08,459
that is it's a test article so we we do

342
00:13:14,569 --> 00:13:10,860
a lot of testing on the

343
00:13:16,850 --> 00:13:14,579
uh the hardware that we actually send on

344
00:13:19,730 --> 00:13:16,860
our missions but we usually build other

345
00:13:21,110 --> 00:13:19,740
copies of them of various fidelities for

346
00:13:23,150 --> 00:13:21,120
different purposes and a lot of that's

347
00:13:26,449 --> 00:13:23,160
figuring out how to make sure it works

348
00:13:28,490 --> 00:13:26,459
figuring out that it can it works as

349
00:13:30,170 --> 00:13:28,500
it's designed to that has the the

350
00:13:32,090 --> 00:13:30,180
margins to make sure that it's going to

351
00:13:33,949 --> 00:13:32,100
be successful and not fail because once

352
00:13:37,670 --> 00:13:33,959
you launch it you can't get it back and

353
00:13:39,710 --> 00:13:37,680
so the one off to my um to my right is

354
00:13:42,110 --> 00:13:39,720
actually designed for mechanical testing

355
00:13:43,990 --> 00:13:42,120
and they do that to make sure that our

356
00:13:48,170 --> 00:13:44,000
big structure

357
00:13:50,230 --> 00:13:48,180
you know can can handle all of the loads

358
00:13:53,329 --> 00:13:50,240
that it goes under through

359
00:13:54,110 --> 00:13:53,339
its test and through

360
00:13:56,810 --> 00:13:54,120
um

361
00:13:58,490 --> 00:13:56,820
uh the the launch and and the rest of

362
00:13:59,990 --> 00:13:58,500
its Mission so those are very important

363
00:14:01,550 --> 00:14:00,000

articles for us more critical Hardware

364
00:14:04,069 --> 00:14:01,560
even though it doesn't actually leave

365
00:14:06,470 --> 00:14:04,079
our planet it's very interesting to see

366
00:14:09,590 --> 00:14:06,480
the the Clone right next to it as well

367
00:14:12,530 --> 00:14:09,600
both in the clean room and next up we

368
00:14:15,230 --> 00:14:12,540
have Alex on Twitter who asks is Europa

369
00:14:16,850 --> 00:14:15,240
literally cool as in cold

370
00:14:19,250 --> 00:14:16,860
that's a great question and yeah the

371
00:14:21,410 --> 00:14:19,260
surface of Europa is not only cool it is

372
00:14:24,410 --> 00:14:21,420
freezing the surface temperature is

373
00:14:26,810 --> 00:14:24,420
about a hundred Kelvin so that is way

374
00:14:29,930 --> 00:14:26,820
below zero so while we know that the

375
00:14:32,030 --> 00:14:29,940
surface is covered with ice that ice is

376
00:14:34,670 --> 00:14:32,040
really really hard it's kind of hard as

377
00:14:36,290 --> 00:14:34,680
a rock so it'd be really hard to say go

378
00:14:38,810 --> 00:14:36,300
ice skating on the surface of Europa

379
00:14:40,970 --> 00:14:38,820
unfortunately well it's kind of nice to

380
00:14:44,629 --> 00:14:40,980
know that it's cool in both senses it's

381
00:14:47,329 --> 00:14:44,639
cool and cool so on fire 1543 on YouTube

382
00:14:49,850 --> 00:14:47,339
asks after it finishes its goals for

383
00:14:52,790 --> 00:14:49,860
Europa would it be able to explore other

384
00:14:53,629 --> 00:14:52,800
moons of Jupiter well that's a good

385
00:14:56,090 --> 00:14:53,639
question

386
00:14:57,769 --> 00:14:56,100
um we would love to be able to send the

387
00:15:00,650 --> 00:14:57,779
Europa Clipper spacecraft to visit other

388
00:15:02,990 --> 00:15:00,660

moons but its main goal is to

389
00:15:05,210 --> 00:15:03,000
investigate Europa so right now we're

390
00:15:07,129 --> 00:15:05,220
we're just really focused on the main

391
00:15:09,829 --> 00:15:07,139
mission of Europa Clipper where it's

392
00:15:12,650 --> 00:15:09,839
going to have about 50 close flybys of

393
00:15:14,509 --> 00:15:12,660
Europa but before it gets to that point

394
00:15:17,269 --> 00:15:14,519
when it first reaches the Jupiter system

395
00:15:19,490 --> 00:15:17,279
we have to go past some of the other

396
00:15:21,530 --> 00:15:19,500
moons to help tweak our orbit around to

397
00:15:24,230 --> 00:15:21,540
actually get to that orbit where we can

398
00:15:26,269 --> 00:15:24,240
fly close by Europa multiple times so we

399
00:15:28,790 --> 00:15:26,279
will have a couple flybys of Ganymede

400
00:15:30,230 --> 00:15:28,800
and Callisto and so you know I would

401
00:15:31,790 --> 00:15:30,240
very much like to turn on the cameras

402
00:15:33,230 --> 00:15:31,800
and do a little calibration at those

403
00:15:34,910 --> 00:15:33,240
moons but we'll see what we're able to

404
00:15:38,210 --> 00:15:34,920
do once we get there well that'd be nice

405
00:15:40,430 --> 00:15:38,220
to see uh we have Emma on LinkedIn who

406
00:15:42,290 --> 00:15:40,440
asks this is for you Jennifer what

407
00:15:44,269 --> 00:15:42,300
instrumentation or functionality of the

408
00:15:48,350 --> 00:15:44,279
Europa Clipper spacecraft are you most

409
00:15:49,329 --> 00:15:48,360
excited about oh that's a good one

410
00:15:55,269 --> 00:15:49,339
um

411
00:15:57,590 --> 00:15:55,279
choose from we love all of our children

412
00:16:00,650 --> 00:15:57,600
and really what's amazing about the

413
00:16:01,610 --> 00:16:00,660

payload is is how well it complements uh

414
00:16:03,590 --> 00:16:01,620
you know all of the different

415
00:16:05,210 --> 00:16:03,600
investigations so

416
00:16:06,350 --> 00:16:05,220
um one of the

417
00:16:11,030 --> 00:16:06,360
um

418
00:16:13,009 --> 00:16:11,040
is actually reason it's a radar it's an

419
00:16:14,090 --> 00:16:13,019
ice penetrating radar and that is going

420
00:16:15,769 --> 00:16:14,100
to

421
00:16:17,389 --> 00:16:15,779
um we we use that when we're very close

422
00:16:20,269 --> 00:16:17,399
to Europa and it's going to help us

423
00:16:23,689 --> 00:16:20,279
understand how thick the ice is whether

424
00:16:25,310 --> 00:16:23,699
or not their subsurface Lakes uh you

425
00:16:28,009 --> 00:16:25,320
know other things like that so that's a

426
00:16:30,949 --> 00:16:28,019
fantastic instrument we have a

427
00:16:32,750 --> 00:16:30,959
magnetometer your Clipper magnetometer

428
00:16:34,990 --> 00:16:32,760
and that really looks at the induced

429
00:16:38,090 --> 00:16:35,000
magnetic field and that's how we know

430
00:16:40,249 --> 00:16:38,100
magnetometry is how we collected the

431
00:16:43,550 --> 00:16:40,259
early evidence that there is an ocean

432
00:16:46,069 --> 00:16:43,560
and so coming back to to that kind of an

433
00:16:47,629 --> 00:16:46,079
instrument is really exciting as well

434
00:16:50,930 --> 00:16:47,639
and that would help us understand

435
00:16:52,610 --> 00:16:50,940
salinity and the the depth of the ocean

436
00:16:54,290 --> 00:16:52,620
I'm looking at Cynthia to make sure I've

437
00:16:58,069 --> 00:16:54,300
got this all right

438
00:16:59,449 --> 00:16:58,079

um and uh you know I know I know I'm

439
00:17:02,449 --> 00:16:59,459
adjacent

440
00:17:03,769 --> 00:17:02,459
um and but I have to admit so so that we

441
00:17:05,510 --> 00:17:03,779
have so many great investigations

442
00:17:07,429 --> 00:17:05,520
there's a mass spectrometer that's going

443
00:17:09,710 --> 00:17:07,439
to look for you know Organics right

444
00:17:13,370 --> 00:17:09,720
that's all that that really interesting

445
00:17:14,750 --> 00:17:13,380
stuff that leads to you know when you're

446
00:17:18,230 --> 00:17:14,760
looking for habitability you're looking

447
00:17:20,870 --> 00:17:18,240
for energy chemistry

448
00:17:23,030 --> 00:17:20,880
and that helps us get to instability

449
00:17:28,010 --> 00:17:23,040
right and so this this these all get to

450
00:17:30,590 --> 00:17:28,020
those but the pictures from the Europa

451
00:17:33,110 --> 00:17:30,600
Imaging system they're going to be

452
00:17:35,690 --> 00:17:33,120
amazing and I you know I I expect that

453
00:17:37,310 --> 00:17:35,700
we're all gonna wallpaper our houses you

454
00:17:39,230 --> 00:17:37,320
know with with images of Europa it's

455
00:17:44,409 --> 00:17:39,240
going to be fantastic that's that's a

456
00:17:50,330 --> 00:17:47,690
and uh speaking of Ezra on YouTube asks

457
00:17:52,669 --> 00:17:50,340
what sensors slash cameras will be used

458
00:17:54,110 --> 00:17:52,679
on Europa clipper

459
00:17:55,370 --> 00:17:54,120
Jeffrey would you like to take that what

460
00:17:57,289 --> 00:17:55,380
cameras

461
00:17:59,810 --> 00:17:57,299
um so I let's see I think we're we're

462
00:18:02,570 --> 00:17:59,820
the the

463
00:18:05,810 --> 00:18:02,580

narrow angle and wide angle cameras from

464
00:18:07,250 --> 00:18:05,820
Ice they use CMOS detectors which is the

465
00:18:09,830 --> 00:18:07,260
same kind of technology that I think you

466
00:18:11,270 --> 00:18:09,840
have in your cell phone camera and so um

467
00:18:13,850 --> 00:18:11,280
you know it just goes to show those are

468
00:18:16,190 --> 00:18:13,860
going everywhere right

469
00:18:18,529 --> 00:18:16,200
um yeah so those are one one is a

470
00:18:20,090 --> 00:18:18,539
refracting telescope where the the light

471
00:18:21,950 --> 00:18:20,100
goes in and gets focused and another one

472
00:18:25,310 --> 00:18:21,960
is reflecting and one of them has a

473
00:18:28,010 --> 00:18:25,320
gimbal so you can move it around and um

474
00:18:29,330 --> 00:18:28,020
uh you know track different specific

475
00:18:34,370 --> 00:18:29,340
areas where you want to get high

476
00:18:38,090 --> 00:18:34,380
resolution and also lets us do a stereo

477
00:18:40,010 --> 00:18:38,100
so you can get some some 3D view of what

478
00:18:41,630 --> 00:18:40,020
the the surface looks like again that's

479
00:18:43,250 --> 00:18:41,640
going to be very interesting for

480
00:18:44,150 --> 00:18:43,260
reconnaissance and for understanding the

481
00:18:47,090 --> 00:18:44,160
geology

482
00:18:50,210 --> 00:18:47,100
lots of angles with those cameras and

483
00:18:53,210 --> 00:18:50,220
let's see we have Richard on LinkedIn

484
00:18:54,830 --> 00:18:53,220
who asks how are you planning the launch

485
00:18:56,750 --> 00:18:54,840
like when are you planning to launch and

486
00:18:58,970 --> 00:18:56,760
how long do you think the flight will be

487
00:19:01,270 --> 00:18:58,980
Ah that's a good question so right now

488
00:19:03,470 --> 00:19:01,280

our planned launch date is in October of

489
00:19:05,930 --> 00:19:03,480
2024. so you don't have to make your

490
00:19:07,909 --> 00:19:05,940
travel plans quite yet but you know I

491
00:19:11,270 --> 00:19:07,919
know where I'm going to be in October of

492
00:19:13,430 --> 00:19:11,280
24 which is in Florida at Cape Kennedy

493
00:19:15,890 --> 00:19:13,440
watching this thing go

494
00:19:17,690 --> 00:19:15,900
um I can't wait and then it takes a long

495
00:19:20,210 --> 00:19:17,700
time to get to Jupiter we're actually

496
00:19:22,310 --> 00:19:20,220
going to swing past Mars first so we'll

497
00:19:24,289 --> 00:19:22,320
go launch from the earth we'll go by

498
00:19:26,450 --> 00:19:24,299
Mars and we'll do a Mars gravity assist

499
00:19:28,730 --> 00:19:26,460
so we'll steal a little bit of energy

500
00:19:31,190 --> 00:19:28,740
from Mars basically the momentum we'll

501
00:19:33,110 --> 00:19:31,200
go past the Earth again and then we'll

502
00:19:35,210 --> 00:19:33,120
finally have enough energy built up to

503
00:19:37,250 --> 00:19:35,220
swing all the way out to the outer solar

504
00:19:39,650 --> 00:19:37,260
system to get to Jupiter so it'll take

505
00:19:42,950 --> 00:19:39,660
about six years before we get to Jupiter

506
00:19:45,169 --> 00:19:42,960
so 2030 is about when we arrive in the

507
00:19:49,250 --> 00:19:45,179
Jupiter system start planning out for 20

508
00:19:51,110 --> 00:19:49,260
30. now too and Evelyn on YouTube asks

509
00:19:53,450 --> 00:19:51,120
if there are habitable conditions

510
00:19:55,370 --> 00:19:53,460
underneath the surface what will be the

511
00:19:57,650 --> 00:19:55,380
next step what instruments will

512
00:19:58,789 --> 00:19:57,660
determine habitable conditions and how

513
00:20:01,130 --> 00:19:58,799

does it work

514
00:20:03,230 --> 00:20:01,140
so Europa Clipper is an amazing

515
00:20:06,950 --> 00:20:03,240
spacecraft and it's going to study

516
00:20:09,169 --> 00:20:06,960
Europa from space so Europa Clipper

517
00:20:11,690 --> 00:20:09,179
isn't going to actually land on Europa

518
00:20:13,610 --> 00:20:11,700
or touch the surface it will be able

519
00:20:15,529 --> 00:20:13,620
though to measure some of the material

520
00:20:18,169 --> 00:20:15,539
that's thrown off of here at the surface

521
00:20:20,090 --> 00:20:18,179
through very small meteorite impacts and

522
00:20:22,070 --> 00:20:20,100
through charged particle impacts this

523
00:20:24,289 --> 00:20:22,080
material in the form of dust and gas

524
00:20:26,750 --> 00:20:24,299
gets thrown into space and it'll

525
00:20:28,669 --> 00:20:26,760
actually be sampled directly by two of

526
00:20:30,230 --> 00:20:28,679
the instruments on Europa Clipper that

527
00:20:32,450 --> 00:20:30,240
Jennifer already mentioned the suda

528
00:20:34,970 --> 00:20:32,460
instrument is a dust analyzer and then

529
00:20:37,549 --> 00:20:34,980
the mass specs instrument is a is a gas

530
00:20:38,990 --> 00:20:37,559
analyzer so those two instruments will

531
00:20:41,570 --> 00:20:39,000
be able to kind of give us our first

532
00:20:43,250 --> 00:20:41,580
taste of europa's composition but if we

533
00:20:45,110 --> 00:20:43,260
really want to study whether or not

534
00:20:47,090 --> 00:20:45,120
there's life on Europa we're going to

535
00:20:48,950 --> 00:20:47,100
have to touch the surface and so I'm

536
00:20:50,690 --> 00:20:48,960
hoping that in the future especially

537
00:20:52,370 --> 00:20:50,700
once we see all those amazing pictures

538
00:20:54,470 --> 00:20:52,380

and the other information that we get

539
00:20:55,970 --> 00:20:54,480
from Europa Clipper that we'll be able

540
00:20:58,549 --> 00:20:55,980
to have a new mission that will actually

541
00:21:01,190 --> 00:20:58,559
land on the surface of Europa scoop up

542
00:21:03,350 --> 00:21:01,200
some that surface material and study it

543
00:21:05,270 --> 00:21:03,360
on board the spacecraft to look for

544
00:21:07,370 --> 00:21:05,280
signs of biosignatures so maybe

545
00:21:09,950 --> 00:21:07,380
compounds or other evidence that might

546
00:21:12,590 --> 00:21:09,960
suggest that maybe there is life there

547
00:21:14,750 --> 00:21:12,600
so that's often the future Europa

548
00:21:16,549 --> 00:21:14,760
Clipper is kind of the first step in a

549
00:21:18,710 --> 00:21:16,559
journey that hopefully will bring us to

550
00:21:21,169 --> 00:21:18,720
understanding really the role of life in

551
00:21:23,450 --> 00:21:21,179
the solar system I can't wait and

552
00:21:26,230 --> 00:21:23,460
actually I actually met Cynthia working

553
00:21:30,409 --> 00:21:26,240
on that concept yeah

554
00:21:32,029 --> 00:21:30,419
so you two go back yeah yeah that's very

555
00:21:33,710 --> 00:21:32,039
exciting and we actually had a really

556
00:21:35,510 --> 00:21:33,720
good follow-up question from Victoria on

557
00:21:37,549 --> 00:21:35,520
LinkedIn who wants to know are we

558
00:21:39,890 --> 00:21:37,559
looking for specific elements molecules

559
00:21:43,370 --> 00:21:39,900
or temperatures ah yeah that's a really

560
00:21:45,470 --> 00:21:43,380
good question so when we're looking for

561
00:21:47,149 --> 00:21:45,480
materials with Europa Clipper we're

562
00:21:50,090 --> 00:21:47,159
going to be looking for kind of simple

563
00:21:52,669 --> 00:21:50,100

materials so we know that there is

564
00:21:55,669 --> 00:21:52,679
there's things like the basic compounds

565
00:21:58,010 --> 00:21:55,679
like carbon oxygen nitrogen hydrogen

566
00:22:00,289 --> 00:21:58,020
phosphorus so sulfur so some of these

567
00:22:02,390 --> 00:22:00,299
materials we've already detected on

568
00:22:04,190 --> 00:22:02,400
europa's Surface using both the

569
00:22:06,110 --> 00:22:04,200
instruments on the Galileo spacecraft as

570
00:22:07,970 --> 00:22:06,120
well as ground-based telescopes that can

571
00:22:11,149 --> 00:22:07,980
actually analyze the composition of

572
00:22:13,850 --> 00:22:11,159
europa's surface and so Europa Clipper

573
00:22:16,010 --> 00:22:13,860
using those direct instruments that I

574
00:22:17,810 --> 00:22:16,020
just talked about suda and mass specs

575
00:22:20,510 --> 00:22:17,820
it'll be able to look for even more

576
00:22:22,789 --> 00:22:20,520
complicated materials so you know maybe

577
00:22:25,190 --> 00:22:22,799
some more complex carbon compounds maybe

578
00:22:27,890 --> 00:22:25,200
some sulfur compounds that are thrown

579
00:22:30,590 --> 00:22:27,900
off the surface and then are detected

580
00:22:32,210 --> 00:22:30,600
directly by these instruments and so

581
00:22:34,130 --> 00:22:32,220
while you know we're not expecting to

582
00:22:35,990 --> 00:22:34,140
get smacked in the face with a fish that

583
00:22:37,850 --> 00:22:36,000
gets thrown off of Europe but we do

584
00:22:39,890 --> 00:22:37,860
think that we can find some really great

585
00:22:41,930 --> 00:22:39,900
information about the details of the

586
00:22:44,390 --> 00:22:41,940
chemistry that's going on either at the

587
00:22:46,730 --> 00:22:44,400
surface of Europa or if there turn out

588
00:22:48,230 --> 00:22:46,740

to be plumes on Europa Europa Clipper

589
00:22:50,149 --> 00:22:48,240
will actually be able to fly through

590
00:22:52,190 --> 00:22:50,159
those plumes and if that's the case

591
00:22:55,250 --> 00:22:52,200
it'll be able to get a much fresher

592
00:22:57,830 --> 00:22:55,260
bigger sample of material that comes

593
00:22:59,570 --> 00:22:57,840
from the subsurface maybe from an

594
00:23:02,029 --> 00:22:59,580
inclusion of liquid wood that's within

595
00:23:04,190 --> 00:23:02,039
the ice shell maybe even from the ocean

596
00:23:07,010 --> 00:23:04,200
depending on how kind of the plumbing

597
00:23:09,289 --> 00:23:07,020
Works inside of Europa so that would be

598
00:23:12,230 --> 00:23:09,299
really fascinating you mentioned oceans

599
00:23:14,149 --> 00:23:12,240
a nasty Nancy on LinkedIn is asking why

600
00:23:15,169 --> 00:23:14,159
do we think there are oceans below the

601
00:23:18,669 --> 00:23:15,179
ice

602
00:23:21,529 --> 00:23:18,679
so this is a great detective story

603
00:23:23,570 --> 00:23:21,539
basically with the Galileo Mission we

604
00:23:25,549 --> 00:23:23,580
knew even before Galileo got there the

605
00:23:27,409 --> 00:23:25,559
Europa surface looked different we knew

606
00:23:29,990 --> 00:23:27,419
it was really bright we knew it was

607
00:23:32,270 --> 00:23:30,000
covered with ice we could tell even from

608
00:23:34,909 --> 00:23:32,280
earth-based telescopes that europa's

609
00:23:37,430 --> 00:23:34,919
surface had a compositional signature a

610
00:23:40,010 --> 00:23:37,440
spectral signature that that tells us

611
00:23:41,450 --> 00:23:40,020
that there was ice at the surface so

612
00:23:44,690 --> 00:23:41,460
there's a big difference though between

613
00:23:47,750 --> 00:23:44,700

solid ice Frozen and then liquid water

614
00:23:50,330 --> 00:23:47,760
and so the Galileo spacecraft got to the

615
00:23:52,789 --> 00:23:50,340
Jupiter system in the 1990s it took all

616
00:23:54,950 --> 00:23:52,799
these pictures that showed places on the

617
00:23:56,930 --> 00:23:54,960
surface where the ice was cracked it was

618
00:23:58,570 --> 00:23:56,940
broken there's even features look kind

619
00:24:01,909 --> 00:23:58,580
of like icebergs

620
00:24:04,549 --> 00:24:01,919
but no direct detections of liquid water

621
00:24:07,330 --> 00:24:04,559
and so we used all of the different

622
00:24:10,070 --> 00:24:07,340
instruments on the Galileo spacecraft

623
00:24:11,750 --> 00:24:10,080
to basically provide multiple lines of

624
00:24:13,730 --> 00:24:11,760
what we call indirect evidence there are

625
00:24:15,710 --> 00:24:13,740
sort of clues that said okay maybe

626
00:24:18,110 --> 00:24:15,720
there's water maybe this could lead to

627
00:24:20,090 --> 00:24:18,120
water we had gravity measurements that

628
00:24:22,250 --> 00:24:20,100
said there's a layer that's a hundred

629
00:24:25,610 --> 00:24:22,260
kilometers thick at the surface that has

630
00:24:26,990 --> 00:24:25,620
the density of ice or water but the

631
00:24:28,669 --> 00:24:27,000
problem is that those measurements were

632
00:24:30,409 --> 00:24:28,679
good enough to distinguish between the

633
00:24:32,330 --> 00:24:30,419
two so we didn't know whether it was ice

634
00:24:34,310 --> 00:24:32,340
all the way down or whether it was a

635
00:24:36,049 --> 00:24:34,320
thin ice layer and then a water layer or

636
00:24:38,090 --> 00:24:36,059
a thick ice layer and then a small water

637
00:24:39,890 --> 00:24:38,100
layer and it turned out actually to be

638
00:24:42,649 --> 00:24:39,900

the magnetic field results as Jennifer

639
00:24:45,169 --> 00:24:42,659
mentioned that were kind of the best

640
00:24:46,789 --> 00:24:45,179
evidence and this you know kind of kills

641
00:24:48,590 --> 00:24:46,799
me as a geologist that I want to look at

642
00:24:50,210 --> 00:24:48,600
my pictures but you know here were these

643
00:24:52,669 --> 00:24:50,220
little Wiggly lines from the magnetic

644
00:24:55,190 --> 00:24:52,679
field measurements that showed what was

645
00:24:57,409 --> 00:24:55,200
really just a beautiful elegant solution

646
00:25:00,230 --> 00:24:57,419
we detected what's called an induced

647
00:25:02,510 --> 00:25:00,240
magnetic field at Europa and that

648
00:25:05,270 --> 00:25:02,520
basically was a signal that could only

649
00:25:08,270 --> 00:25:05,280
come from a global conducting layer

650
00:25:10,190 --> 00:25:08,280
beneath Europa surface and it turns out

651
00:25:13,190 --> 00:25:10,200
if you run the numbers that salt water

652
00:25:14,810 --> 00:25:13,200
so a salty water ocean with you know

653
00:25:16,669 --> 00:25:14,820
kind of a salinity a salt level that's

654
00:25:19,909 --> 00:25:16,679
pretty pretty similar to Earth's oceans

655
00:25:22,190 --> 00:25:19,919
actually that this salt water layer if

656
00:25:24,830 --> 00:25:22,200
it was Global and if it was consistent

657
00:25:27,649 --> 00:25:24,840
with that hundred kilometers of ice and

658
00:25:29,870 --> 00:25:27,659
water a pretty a pretty big chunk of

659
00:25:32,930 --> 00:25:29,880
that had to be liquid so that was really

660
00:25:34,690 --> 00:25:32,940
the best explanation that we had for the

661
00:25:37,310 --> 00:25:34,700
signals we saw from the magnetic field

662
00:25:39,830 --> 00:25:37,320
and that's why we think there's an ocean

663
00:25:41,810 --> 00:25:39,840

and so Europa Clipper 20 years later

664
00:25:43,610 --> 00:25:41,820
it's going to go back over 30 years

665
00:25:45,409 --> 00:25:43,620
later almost by the time it gets there

666
00:25:47,149 --> 00:25:45,419
it's going to go back and it's going to

667
00:25:50,630 --> 00:25:47,159
confirm that there's an ocean there we

668
00:25:52,730 --> 00:25:50,640
hope and we were hoping that the reason

669
00:25:54,830 --> 00:25:52,740
radar instrument that Jennifer mentioned

670
00:25:57,289 --> 00:25:54,840
will be able to actually see through

671
00:25:59,990 --> 00:25:57,299
that ice layer and it'll be able to look

672
00:26:02,630 --> 00:26:00,000
for maybe Pockets or lakes of liquid

673
00:26:04,370 --> 00:26:02,640
within the ice shell and maybe it'll

674
00:26:07,010 --> 00:26:04,380
even be able to tell us how thick that

675
00:26:10,190 --> 00:26:07,020
ice layer is and where the ocean starts

676
00:26:11,510 --> 00:26:10,200
so we're excited it's so interesting to

677
00:26:13,430 --> 00:26:11,520
hear how some of these instruments will

678
00:26:16,909 --> 00:26:13,440
help answer some of your questions that

679
00:26:18,830 --> 00:26:16,919
you have too now Tamisha on YouTube asks

680
00:26:20,930 --> 00:26:18,840
what will happen when the mission ends

681
00:26:22,549 --> 00:26:20,940
will it be deorbited into Jupiter to

682
00:26:25,730 --> 00:26:22,559
protect other moons from contamination

683
00:26:26,750 --> 00:26:25,740
or will it be deorbited into somewhere

684
00:26:28,190 --> 00:26:26,760
else

685
00:26:32,210 --> 00:26:28,200
great question

686
00:26:35,450 --> 00:26:32,220
um we we do deorbit and and as

687
00:26:39,590 --> 00:26:35,460
um the uh

688
00:26:40,810 --> 00:26:39,600

Oscar mentioned the name slips to Mish

689
00:26:43,610 --> 00:26:40,820
to Mish

690
00:26:45,289 --> 00:26:43,620
mentions it's it's to protect

691
00:26:47,570 --> 00:26:45,299
um the the environments right you don't

692
00:26:48,470 --> 00:26:47,580
want to go and introduce a whole bunch

693
00:26:51,769 --> 00:26:48,480
of

694
00:26:54,470 --> 00:26:51,779
um uh microbes or things like that from

695
00:26:56,090 --> 00:26:54,480
Earth right because that would interfere

696
00:26:57,769 --> 00:26:56,100
with our signal and our experiments in

697
00:26:59,950 --> 00:26:57,779
the future and that's not considered

698
00:27:03,110 --> 00:26:59,960
good form in the science community

699
00:27:06,169 --> 00:27:03,120
and our original plan was to de-orbit

700
00:27:09,110 --> 00:27:06,179
into Jupiter but recently I think over

701
00:27:10,850 --> 00:27:09,120
the past year maybe in a bit we worked

702
00:27:14,230 --> 00:27:10,860
with headquarters and the planetary

703
00:27:18,350 --> 00:27:14,240
Protection Officer and and Community to

704
00:27:20,330 --> 00:27:18,360
change that from deorbiting into Jupiter

705
00:27:23,269 --> 00:27:20,340
to going into Ganymede and the reason we

706
00:27:24,669 --> 00:27:23,279
wanted to do that is because we're able

707
00:27:28,549 --> 00:27:24,679
to

708
00:27:30,710 --> 00:27:28,559
uh uh essentially get there much uh with

709
00:27:33,289 --> 00:27:30,720
much less work it actually takes more

710
00:27:36,110 --> 00:27:33,299
effort more time to go from the orbit

711
00:27:38,330 --> 00:27:36,120
where we're flying by Europa to actually

712
00:27:41,810 --> 00:27:38,340
impacting into Jupiter and it's it's

713
00:27:43,549 --> 00:27:41,820

much less of an adjustment to uh go to

714
00:27:45,409 --> 00:27:43,559
one of the other moons and what that

715
00:27:49,190 --> 00:27:45,419
lets us do is maximize the amount of

716
00:27:52,070 --> 00:27:49,200
time for science because we need to make

717
00:27:55,190 --> 00:27:52,080
sure that we're able to accomplish that

718
00:27:57,830 --> 00:27:55,200
end of mission and and know that

719
00:27:59,570 --> 00:27:57,840
everything on the uh on the spacecraft

720
00:28:01,130 --> 00:27:59,580
is working properly and we have very

721
00:28:02,330 --> 00:28:01,140
high confidence again as a protection

722
00:28:05,029 --> 00:28:02,340
for the environments that we're

723
00:28:06,950 --> 00:28:05,039
interested in studying okay and I have

724
00:28:09,169 --> 00:28:06,960
one last question it's from Tara on

725
00:28:11,330 --> 00:28:09,179
Twitter who asks Jennifer and Cynthia

726
00:28:13,970 --> 00:28:11,340
how does it feel to be such amazing

727
00:28:16,909 --> 00:28:13,980
champions of women on stem your

728
00:28:20,149 --> 00:28:16,919
incredible Role Models well thank you

729
00:28:21,710 --> 00:28:20,159
that's really sweet yeah it really does

730
00:28:23,930 --> 00:28:21,720
and and one of the cool things about

731
00:28:25,970 --> 00:28:23,940
working somewhere like JPL is that we're

732
00:28:27,649 --> 00:28:25,980
not alone there are so many amazing

733
00:28:29,630 --> 00:28:27,659
women who work here who work on the

734
00:28:31,669 --> 00:28:29,640
Europa Clipper mission on all the other

735
00:28:33,549 --> 00:28:31,679
missions all the way up to our Lori

736
00:28:36,230 --> 00:28:33,559
lesson who's our new JPL lab director

737
00:28:38,029 --> 00:28:36,240
there's amazing women who work here and

738
00:28:39,769 --> 00:28:38,039

it's just it's fantastic to get to work

739
00:28:41,630 --> 00:28:39,779
with people like Jennifer and all the

740
00:28:44,029 --> 00:28:41,640
rest of them too it and it's really been

741
00:28:46,130 --> 00:28:44,039
an evolution and a pleasure when I first

742
00:28:48,830 --> 00:28:46,140
came to JPL I won't say how long ago but

743
00:28:52,010 --> 00:28:48,840
it was a really long time ago I was

744
00:28:55,250 --> 00:28:52,020
almost always the only woman in the room

745
00:28:56,990 --> 00:28:55,260
right and over the years you know you

746
00:29:00,590 --> 00:28:57,000
look around and all of a sudden you know

747
00:29:03,710 --> 00:29:00,600
many of of the the folks in key roles

748
00:29:06,289 --> 00:29:03,720
are mission assurance manager is a is a

749
00:29:08,570 --> 00:29:06,299
women are you know our director for

750
00:29:10,010 --> 00:29:08,580
right so people up the chain we we just

751
00:29:12,409 --> 00:29:10,020
had a project manager that was a woman

752
00:29:15,289 --> 00:29:12,419
so our flight system and chairs so

753
00:29:17,330 --> 00:29:15,299
they're you know we just we have such

754
00:29:19,430 --> 00:29:17,340
great representation now and and I think

755
00:29:22,130 --> 00:29:19,440
in particular on Clipper

756
00:29:23,990 --> 00:29:22,140
um so it's been it's it it's been really

757
00:29:24,710 --> 00:29:24,000
a great

758
00:29:26,810 --> 00:29:24,720
um

759
00:29:29,389 --> 00:29:26,820
I guess

760
00:29:31,610 --> 00:29:29,399
um progress you know that we that we've

761
00:29:33,049 --> 00:29:31,620
really enjoyed watching it's really

762
00:29:34,730 --> 00:29:33,059
exciting to hear even the story how

763
00:29:38,090 --> 00:29:34,740

YouTube met was very cool to find out

764
00:29:40,130 --> 00:29:38,100
today well that is unfortunately all the

765
00:29:42,289 --> 00:29:40,140
time we have for questions today now

766
00:29:45,529 --> 00:29:42,299
Europa Clipper is on track for a launch

767
00:29:48,470 --> 00:29:45,539
in 2024 so to learn more about the

768
00:29:51,289 --> 00:29:48,480
mission visit europa.nasa.gov

769
00:29:53,389 --> 00:29:51,299
and be sure to check out the 24 7 live

770
00:29:55,730 --> 00:29:53,399
cam they'll be running the next several

771
00:29:57,830 --> 00:29:55,740
months on the NASA JPL YouTube channel

772
00:30:00,529 --> 00:29:57,840
and we'll keep answering your questions

773
00:30:03,649 --> 00:30:00,539
there with a moderated chat every

774
00:30:06,529 --> 00:30:03,659
Tuesday at 10 A.M Pacific time you can

775
00:30:09,169 --> 00:30:06,539
also follow JPL on social media to see

776
00:30:10,850 --> 00:30:09,179
the Juno spacecraft images of Europa

777
00:30:13,190 --> 00:30:10,860
later this week which will be very

778
00:30:15,470 --> 00:30:13,200
exciting for us all yeah and thank you

779
00:30:17,330 --> 00:30:15,480
to our guests and thank you so much for