

1
00:00:00,000 --> 00:00:12,710
here tonight I'm dr. Frank summers from

2
00:00:03,350 --> 00:00:18,629
outreach Mic Check Mic Check it's out

3
00:00:12,710 --> 00:00:21,570
get my voice right other question do we

4
00:00:18,629 --> 00:00:22,919
have enough lithographs as we have we

5
00:00:21,570 --> 00:00:26,730
have a rather large audience because

6
00:00:22,920 --> 00:00:28,140
Kourtney is obviously famous do we need

7
00:00:26,730 --> 00:00:32,039
more lithographs do I need to go grab

8
00:00:28,140 --> 00:00:34,109
some at the halftime we seem to be okay

9
00:00:32,039 --> 00:00:36,179
or somebody saying yes we need more okay

10
00:00:34,109 --> 00:00:39,500
I'll get more all right all right Thomas

11
00:00:36,179 --> 00:00:39,500
let's get started

12
00:00:39,890 --> 00:00:44,128
good evening ladies and gentlemen I am

13
00:00:42,179 --> 00:00:46,409
dr. Frank summers from the office of

14
00:00:44,128 --> 00:00:49,079
public outreach and it is my pleasure to

15
00:00:46,409 --> 00:00:52,468
be your host for the public lecture

16
00:00:49,079 --> 00:00:54,929
series tonight when you came in there

17
00:00:52,469 --> 00:00:57,539
are images of the jovian planets over

18
00:00:54,929 --> 00:01:00,750
here and over here if you didn't get one

19
00:00:57,539 --> 00:01:03,000
grab one on the way out and if you don't

20
00:01:00,750 --> 00:01:04,739
know what jovian planets are well you

21
00:01:03,000 --> 00:01:07,079
didn't pay attention in school or they

22
00:01:04,739 --> 00:01:08,850
didn't use the term Jovian uh-huh but

23
00:01:07,079 --> 00:01:12,658
look on the back of the lithograph and

24
00:01:08,849 --> 00:01:15,390
they will explain it all to you tonight

25
00:01:12,659 --> 00:01:17,759
our speaker is Courtney McManus this is

26
00:01:15,390 --> 00:01:19,739
this is one of the fun things okay that

27
00:01:17,759 --> 00:01:22,618
we get to do here we get to tell you the

28
00:01:19,739 --> 00:01:24,989
inside story of what goes on behind the

29

00:01:22,618 --> 00:01:26,849
scenes of these amazing programs so this

30
00:01:24,989 --> 00:01:29,129
is the view from Mission Operations I

31
00:01:26,849 --> 00:01:32,399
know very little about it so I'm looking

32
00:01:29,129 --> 00:01:33,530
forward to hearing all this talk let's

33
00:01:32,400 --> 00:01:38,040
see next month

34
00:01:33,530 --> 00:01:39,599
Nolan Walborn will be talking on active

35
00:01:38,040 --> 00:01:41,970
luminous blue variables in the large

36
00:01:39,599 --> 00:01:44,158
magellanic cloud and if you want to know

37
00:01:41,969 --> 00:01:46,950
what that means show up he sent me his

38
00:01:44,159 --> 00:01:50,329
abstract today and it looks like it's a

39
00:01:46,950 --> 00:01:53,609
nice juicy science topic talking about

40
00:01:50,328 --> 00:01:57,868
some very very bright stars in a

41
00:01:53,609 --> 00:01:59,670
satellite galaxy in October oh we have a

42
00:01:57,868 --> 00:02:01,739
really another really special talk

43
00:01:59,670 --> 00:02:06,750

because because the Cassini mission has

44

00:02:01,739 --> 00:02:08,939
been at Saturn for over a decade amazing

45

00:02:06,750 --> 00:02:10,439
images and its grand finale is

46

00:02:08,939 --> 00:02:13,379
mid-september I think it's like

47

00:02:10,439 --> 00:02:15,990
September 15th all right and so on

48

00:02:13,379 --> 00:02:19,289
tober third bonny monkey our saturn

49

00:02:15,990 --> 00:02:21,210
specialist here it's based health scope

50

00:02:19,289 --> 00:02:24,030
we'll be telling you all about Cassini's

51

00:02:21,210 --> 00:02:25,590
grand finale and i don't know what

52

00:02:24,030 --> 00:02:27,120
she'll be talking about she doesn't know

53

00:02:25,590 --> 00:02:29,099
what she'll be talking about because it

54

00:02:27,120 --> 00:02:31,140
hasn't happened yet so she will be

55

00:02:29,099 --> 00:02:34,229
spending the last two weeks of of

56

00:02:31,139 --> 00:02:36,239
September creating this amazing talk for

57

00:02:34,229 --> 00:02:37,349
you of course there's always stuff that

58
00:02:36,240 --> 00:02:39,360
Cassini has done before

59
00:02:37,349 --> 00:02:43,560
all right November we have the famous

60
00:02:39,360 --> 00:02:46,050
TBA which means I need to get on email

61
00:02:43,560 --> 00:02:47,819
and start twisting people's arms if you

62
00:02:46,050 --> 00:02:49,830
want to find out whose arm I do twist

63
00:02:47,819 --> 00:02:53,219
you can check our public lecture series

64
00:02:49,830 --> 00:02:54,750
website if you just go to your favorite

65
00:02:53,219 --> 00:02:56,849
favorite search engine

66
00:02:54,750 --> 00:02:59,009
typing Hubbell public talks you will

67
00:02:56,849 --> 00:03:01,229
find this web page where we have the

68
00:02:59,009 --> 00:03:04,439
list of the upcoming lectures we have

69
00:03:01,229 --> 00:03:07,199
the links to watch the live streams on

70
00:03:04,439 --> 00:03:09,810
the first Tuesday of every month as well

71
00:03:07,199 --> 00:03:12,810
as the list for the archives of the past

72
00:03:09,810 --> 00:03:14,280
lectures also if you would like to sign

73
00:03:12,810 --> 00:03:17,670
up for our mailing list this is the

74
00:03:14,280 --> 00:03:20,069
easiest way to do so just enter your

75
00:03:17,669 --> 00:03:24,659
email here hit that subscribe button and

76
00:03:20,069 --> 00:03:27,209
it will sign you up for our emails the

77
00:03:24,659 --> 00:03:28,530
announcements if you don't want to sign

78
00:03:27,210 --> 00:03:30,570
up at the website you can just provide

79
00:03:28,530 --> 00:03:33,210
your email address to me somebody

80
00:03:30,569 --> 00:03:36,030
already did that this evening and I will

81
00:03:33,210 --> 00:03:38,820
do my best to get you on there okay and

82
00:03:36,030 --> 00:03:42,569
I think we've got a perfect record of no

83
00:03:38,819 --> 00:03:44,699
spam ever on that email list if you have

84
00:03:42,569 --> 00:03:48,269
comments or questions you can also send

85
00:03:44,699 --> 00:03:53,639
them to us at public lecture at STScI

86

00:03:48,270 --> 00:03:56,130
dot edu social media I updated this

87
00:03:53,639 --> 00:03:58,319
because we've got a new push on a social

88
00:03:56,129 --> 00:04:00,569
media you know we've been known as the

89
00:03:58,319 --> 00:04:02,489
home of hubble right but what's

90
00:04:00,569 --> 00:04:04,859
happening next year the James Webb Space

91
00:04:02,490 --> 00:04:06,719
Telescope is launching so we aren't just

92
00:04:04,860 --> 00:04:09,210
the Hubble place we're also going to be

93
00:04:06,719 --> 00:04:10,949
the James Webb place and well we're

94
00:04:09,210 --> 00:04:12,870
really the Space Telescope Science

95
00:04:10,949 --> 00:04:15,000
Institute so our social media is

96
00:04:12,870 --> 00:04:17,009
expanding from just Hubble to also

97
00:04:15,000 --> 00:04:19,230
including a STScI

98
00:04:17,009 --> 00:04:23,490
so on Facebook we have Hubble telescope

99
00:04:19,230 --> 00:04:25,890
we also have our stsci page on facebook

100
00:04:23,490 --> 00:04:27,300

twitter has Hubble telescope as well as

101

00:04:25,889 --> 00:04:29,370
Space Telescope

102

00:04:27,300 --> 00:04:31,139
you - we just have Hubble sight Channel

103

00:04:29,370 --> 00:04:33,360
and on Instagram we have Space

104

00:04:31,139 --> 00:04:36,509
Telescope's so I think you'll see our

105

00:04:33,360 --> 00:04:38,370
branding grow beyond just being Hubble

106

00:04:36,509 --> 00:04:39,810
Hubble and Webb and being Space

107

00:04:38,370 --> 00:04:41,848
Telescope's over the next couple years

108

00:04:39,810 --> 00:04:44,819
so that's something to look forward to

109

00:04:41,848 --> 00:04:47,128
for myself you can follow me on Facebook

110

00:04:44,819 --> 00:04:49,020
Google+ or Twitter I don't do a heck of

111

00:04:47,129 --> 00:04:55,020
a lot of it so it's not the most

112

00:04:49,019 --> 00:04:58,680
exciting exciting not a very very full

113

00:04:55,019 --> 00:05:01,378
feed how about that okay Observatory I

114

00:04:58,680 --> 00:05:04,288
did not get an email but it was raining

115
00:05:01,379 --> 00:05:06,590
at 6:00 p.m. did it clear up since then

116
00:05:04,288 --> 00:05:09,180
you guys coming in somebody saying yes

117
00:05:06,589 --> 00:05:11,758
okay a little bit all right so we're not

118
00:05:09,180 --> 00:05:13,769
sure whether there will be observing but

119
00:05:11,759 --> 00:05:16,319
that person will show up around 9:00

120
00:05:13,769 --> 00:05:19,620
9:15 and remind me at the end of the

121
00:05:16,319 --> 00:05:22,080
talk to ask if arena is here okay okay

122
00:05:19,620 --> 00:05:24,889
and now our news from the universe for

123
00:05:22,079 --> 00:05:28,439
August 2017

124
00:05:24,889 --> 00:05:32,699
our first story tonight giant arc

125
00:05:28,439 --> 00:05:34,740
reveals tiny details all right so we're

126
00:05:32,699 --> 00:05:36,240
talking about gravitational lensing and

127
00:05:34,740 --> 00:05:38,759
actually we've had a lot of stories

128
00:05:36,240 --> 00:05:41,430
lately about gravitational lensing this

129
00:05:38,759 --> 00:05:43,288
is gravitational lensing by a cluster of

130
00:05:41,430 --> 00:05:45,269
galaxies and so the configuration is

131
00:05:43,288 --> 00:05:47,339
Hubble's down here we've got this giant

132
00:05:45,269 --> 00:05:50,339
cluster of galaxies here and we've got

133
00:05:47,339 --> 00:05:52,348
this very distant galaxy here and the

134
00:05:50,339 --> 00:05:56,818
light from that very distant galaxy

135
00:05:52,348 --> 00:05:58,319
passes by this large cluster and due to

136
00:05:56,819 --> 00:06:02,158
an effect of general relativity actually

137
00:05:58,319 --> 00:06:03,990
gets bent because general relativity has

138
00:06:02,158 --> 00:06:08,028
everybody in the back of the room knows

139
00:06:03,990 --> 00:06:12,449
can be boiled down to three words mass

140
00:06:08,028 --> 00:06:13,620
warps space okay that's what you need to

141
00:06:12,449 --> 00:06:16,860
know about general relativity and the

142
00:06:13,620 --> 00:06:20,129
mass of this cluster warped space so

143

00:06:16,860 --> 00:06:23,069
much that the light bends as it goes

144
00:06:20,129 --> 00:06:24,778
past that cluster so the cluster of

145
00:06:23,069 --> 00:06:27,710
galaxies the mass of the cluster of

146
00:06:24,778 --> 00:06:30,778
galaxies acts as a gravitational lens

147
00:06:27,709 --> 00:06:32,638
all right and so when Hubble looks at

148
00:06:30,778 --> 00:06:34,860
these giant these big clusters of

149
00:06:32,639 --> 00:06:38,158
galaxies we can get lensing effects like

150
00:06:34,860 --> 00:06:40,759
this which is an arc and this is a

151
00:06:38,158 --> 00:06:42,110
distant galaxies whose light has passed

152
00:06:40,759 --> 00:06:44,980
through that cluster and become

153
00:06:42,110 --> 00:06:47,720
stretched out as it passes through

154
00:06:44,980 --> 00:06:49,310
alright and so this one is actually a

155
00:06:47,720 --> 00:06:51,410
very big arc there are actually a lot of

156
00:06:49,310 --> 00:06:53,120
smaller arcs like that one here and

157
00:06:51,410 --> 00:06:55,850

there are a couple other smaller arcs

158

00:06:53,120 --> 00:07:00,199

that you can see in this image but this

159

00:06:55,850 --> 00:07:04,400

is a giant arc and there was a survey by

160

00:07:00,199 --> 00:07:07,430

the Sloan Digital Sky Survey to look for

161

00:07:04,399 --> 00:07:09,319

these giant arcs in Sloan and which is a

162

00:07:07,430 --> 00:07:10,850

ground-based telescope and then do

163

00:07:09,319 --> 00:07:13,399

follow up with the Hubble Space

164

00:07:10,850 --> 00:07:15,620

Telescope and so we did follow up with

165

00:07:13,399 --> 00:07:18,259

Hubble of this one all right and let me

166

00:07:15,620 --> 00:07:21,889

blow it up for you and this giant arc is

167

00:07:18,259 --> 00:07:24,199

not one yeah well it is one galaxy but

168

00:07:21,889 --> 00:07:27,110

it's the same galaxies three different

169

00:07:24,199 --> 00:07:29,899

times it's a triple lens of the same

170

00:07:27,110 --> 00:07:31,970

galaxy so you can see one image of it

171

00:07:29,899 --> 00:07:35,149

here one image of it in the center and

172
00:07:31,970 --> 00:07:36,860
one image of it down here and that's one

173
00:07:35,149 --> 00:07:41,719
of the reason it makes this really long

174
00:07:36,860 --> 00:07:46,639
arc okay and this galaxy is observed

175
00:07:41,720 --> 00:07:49,040
from 11 billion light-years away right

176
00:07:46,639 --> 00:07:52,310
and we could not really see it very well

177
00:07:49,040 --> 00:07:55,430
at all if it wasn't for the cluster of

178
00:07:52,310 --> 00:07:56,689
galaxies lensing it it's magnified about

179
00:07:55,430 --> 00:08:01,129
30 times

180
00:07:56,689 --> 00:08:02,779
it's brightened up it's also expanded so

181
00:08:01,129 --> 00:08:04,969
what they did with this is they use

182
00:08:02,779 --> 00:08:07,639
their model of the mass of the cluster

183
00:08:04,970 --> 00:08:10,100
of galaxies to try and reconstruct what

184
00:08:07,639 --> 00:08:11,479
this galaxy originally look like before

185
00:08:10,100 --> 00:08:13,250
it went through the lensing because it's

186
00:08:11,480 --> 00:08:15,590
distorted a little bit alright and so

187
00:08:13,250 --> 00:08:17,569
they reconstructed what they thought

188
00:08:15,589 --> 00:08:19,969
think this galaxy actually looks like

189
00:08:17,569 --> 00:08:22,759
before it gets distorted by the

190
00:08:19,970 --> 00:08:25,010
gravitational lensing and what they

191
00:08:22,759 --> 00:08:27,170
measured was that due to the

192
00:08:25,009 --> 00:08:30,949
gravitational lensing they're able to

193
00:08:27,170 --> 00:08:33,560
get about ten times the resolution that

194
00:08:30,949 --> 00:08:36,168
Hubble would get normally all right with

195
00:08:33,559 --> 00:08:38,929
the lensing it's stretched out magnified

196
00:08:36,168 --> 00:08:40,879
enough they're able to see finer details

197
00:08:38,929 --> 00:08:43,579
than Hubble could without the

198
00:08:40,879 --> 00:08:45,769
gravitational lensing as I said this

199
00:08:43,580 --> 00:08:50,600
galaxy is 11 billion light-years away

200

00:08:45,769 --> 00:08:54,049
which means we're seeing it as it was 11

201
00:08:50,600 --> 00:08:54,440
billion years ago because it takes a

202
00:08:54,049 --> 00:08:55,969
billion

203
00:08:54,440 --> 00:08:59,630
years to cross a billion light-years of

204
00:08:55,970 --> 00:09:02,629
space this is a galaxy seen 11 billion

205
00:08:59,629 --> 00:09:05,899
years ago when galaxies were still

206
00:09:02,629 --> 00:09:08,840
developing and at that time these small

207
00:09:05,899 --> 00:09:11,269
galaxies were undergoing massive bursts

208
00:09:08,840 --> 00:09:13,220
of star formation and you can see in the

209
00:09:11,269 --> 00:09:17,389
reconstruction all these bright small

210
00:09:13,220 --> 00:09:20,360
dots right that is the Stars star

211
00:09:17,389 --> 00:09:23,539
formation regions bursting to life 11

212
00:09:20,360 --> 00:09:25,759
billion years ago and we have known from

213
00:09:23,539 --> 00:09:27,439
other observations that we'd get a lot

214
00:09:25,759 --> 00:09:31,069

of star formation we get these star

215

00:09:27,440 --> 00:09:32,600

bursts early on in the universe but with

216

00:09:31,070 --> 00:09:35,510

this we're able to see them in

217

00:09:32,600 --> 00:09:37,250

unprecedented detail because it's even

218

00:09:35,509 --> 00:09:39,710

higher resolution than Hubble can get

219

00:09:37,250 --> 00:09:41,779

due to the lensing we're able to see

220

00:09:39,710 --> 00:09:43,450

these small star forming regions that

221

00:09:41,779 --> 00:09:45,620

are only hundreds of light-years across

222

00:09:43,450 --> 00:09:46,790

whereas normally Hubble would only be

223

00:09:45,620 --> 00:09:48,679

able to see things thousands of

224

00:09:46,789 --> 00:09:50,419

light-years across and the sort of all

225

00:09:48,679 --> 00:09:52,969

the star bursting would be blurred

226

00:09:50,419 --> 00:09:55,759

together now we're able to see that

227

00:09:52,970 --> 00:10:00,190

individual star bursting in this galaxy

228

00:09:55,759 --> 00:10:04,009

due to the giant arc helping us to

229
00:10:00,190 --> 00:10:08,960
resolve very tiny details in this very

230
00:10:04,009 --> 00:10:10,250
distant galaxy that's really cool oh and

231
00:10:08,960 --> 00:10:12,470
by the way this is an artist's

232
00:10:10,250 --> 00:10:14,269
illustration of what's going on this is

233
00:10:12,470 --> 00:10:16,310
the galaxy seen mostly edge-on

234
00:10:14,269 --> 00:10:18,379
and you got all these wonderful star

235
00:10:16,309 --> 00:10:19,819
bursting things going on all right we

236
00:10:18,379 --> 00:10:23,000
like to add the pretty pictures because

237
00:10:19,820 --> 00:10:25,280
well that's only so pretty and this

238
00:10:23,000 --> 00:10:26,629
gives you an idea help your imagination

239
00:10:25,279 --> 00:10:35,029
look what it might have looked like

240
00:10:26,629 --> 00:10:36,500
eleven billion years ago question that's

241
00:10:35,029 --> 00:10:38,480
the view of the galaxy the galaxy is not

242
00:10:36,500 --> 00:10:40,129
distorted only the light is described no

243
00:10:38,480 --> 00:10:51,980
Alexei's were harmed in the creation of

244
00:10:40,129 --> 00:10:53,799
that all right so Mars and Earth go

245
00:10:51,980 --> 00:10:56,060
through what's called opposition every

246
00:10:53,799 --> 00:10:56,870
26 months I think it is every two years

247
00:10:56,059 --> 00:10:59,269
in two months

248
00:10:56,870 --> 00:11:01,159
okay and this is a diagram showing you

249
00:10:59,269 --> 00:11:02,629
all the some of the opposite and

250
00:11:01,159 --> 00:11:04,759
pictures Hubble has taken so whenever

251
00:11:02,629 --> 00:11:06,710
Earth and Mars are at their closest

252
00:11:04,759 --> 00:11:08,210
Hubble takes a picture and we put

253
00:11:06,710 --> 00:11:11,540
out there and the public loves it okay

254
00:11:08,210 --> 00:11:14,870
because sorry the public loves a solar

255
00:11:11,539 --> 00:11:18,289
system pictures so we did one in 1995

256
00:11:14,870 --> 00:11:21,529
and in 97 and 99 and 2000 one in 2003

257

00:11:18,289 --> 00:11:24,289
2005 and 2007 okay so this was you know

258
00:11:21,529 --> 00:11:26,299
a procession of all these to various

259
00:11:24,289 --> 00:11:30,469
opposition's so we've continued to do

260
00:11:26,299 --> 00:11:33,109
that over the years and last year 2016

261
00:11:30,470 --> 00:11:36,080
in May we also took a picture of Mars

262
00:11:33,110 --> 00:11:38,000
getting close to opposition and what we

263
00:11:36,080 --> 00:11:39,440
showed you about it this time cuz we've

264
00:11:38,000 --> 00:11:41,570
done this so many times we got to talk

265
00:11:39,440 --> 00:11:43,190
about new things each time well this

266
00:11:41,570 --> 00:11:44,720
time we talked about all the different

267
00:11:43,190 --> 00:11:47,090
features on the surface of Mars that

268
00:11:44,720 --> 00:11:50,570
Hubble could resolve the clouds above

269
00:11:47,090 --> 00:11:53,530
syrtris major chaparral a crater the

270
00:11:50,570 --> 00:11:57,290
North Pole and so on and so forth

271
00:11:53,529 --> 00:11:59,659

but we didn't tell you what we didn't

272

00:11:57,289 --> 00:12:02,169

tell you was during those observations

273

00:11:59,659 --> 00:12:05,839

we took a bunch of observations

274

00:12:02,169 --> 00:12:08,419

Mars's moon Phobos appeared in 13 of

275

00:12:05,840 --> 00:12:09,920

those observations alright and for those

276

00:12:08,419 --> 00:12:11,839

of you on the web you may not be able to

277

00:12:09,919 --> 00:12:15,019

see those dots so I'm gonna circle them

278

00:12:11,840 --> 00:12:19,190

all right alright this is a composite of

279

00:12:15,019 --> 00:12:21,289

13 observations including Phobos being

280

00:12:19,190 --> 00:12:24,260

along here alright so they actually

281

00:12:21,289 --> 00:12:26,509

timed it to try and see what they could

282

00:12:24,259 --> 00:12:28,549

see about this tiny moon because this is

283

00:12:26,509 --> 00:12:30,500

only you know tens kilometers across

284

00:12:28,549 --> 00:12:33,079

this is a this is a captured asteroid

285

00:12:30,500 --> 00:12:34,850

actually okay it's not it's not a moon

286
00:12:33,080 --> 00:12:36,800
that formed with Mars it's a moon that

287
00:12:34,850 --> 00:12:39,320
got captured by Mars both Phobos and

288
00:12:36,799 --> 00:12:41,979
Deimos are these tiny moons around Mars

289
00:12:39,320 --> 00:12:45,740
that are really almost assuredly

290
00:12:41,980 --> 00:12:48,259
captured asteroids all right and so here

291
00:12:45,740 --> 00:12:51,740
is the data sequence all right and you

292
00:12:48,259 --> 00:12:54,350
can see Phobos moving here you'll also

293
00:12:51,740 --> 00:12:57,080
see Mars flipping through it because we

294
00:12:54,350 --> 00:12:59,180
got different different observations

295
00:12:57,080 --> 00:13:02,000
during different Hubble orbits alright

296
00:12:59,179 --> 00:13:04,879
and so Mars goes through and this is the

297
00:13:02,000 --> 00:13:06,950
actual data okay but if you want to make

298
00:13:04,879 --> 00:13:08,870
a movie this kind of jumpiness doesn't

299
00:13:06,950 --> 00:13:12,080
work doesn't work so what we did is we

300
00:13:08,870 --> 00:13:14,929
had our video guy apply his special

301
00:13:12,080 --> 00:13:19,100
magic to it and now we have a smooth

302
00:13:14,929 --> 00:13:20,588
sequence that shows Phobos progressing

303
00:13:19,100 --> 00:13:22,959
through those 13 different sea

304
00:13:20,589 --> 00:13:27,189
and you'll notice Mars here turns

305
00:13:22,958 --> 00:13:28,778
relatively smoothly as well and we

306
00:13:27,188 --> 00:13:30,759
didn't come up with this name actually

307
00:13:28,778 --> 00:13:34,269
got her Space Flight Center use the

308
00:13:30,759 --> 00:13:36,730
phrase Phobos photobombing and it caught

309
00:13:34,269 --> 00:13:38,350
on really well on the internet and so I

310
00:13:36,730 --> 00:13:41,860
picked it up I'm sorry that's a cool

311
00:13:38,350 --> 00:13:46,480
name so this is Phobos photobombing our

312
00:13:41,860 --> 00:13:48,909
picture of Mars alright final thing

313
00:13:46,480 --> 00:13:51,699
where will you be when the light goes

314

00:13:48,909 --> 00:13:53,318
out I have to it's it's we've been

315
00:13:51,698 --> 00:13:55,719
waiting for this for how long

316
00:13:53,318 --> 00:13:58,958
alright it's finally 2017 it's finally

317
00:13:55,720 --> 00:14:01,569
August 2017 and the total solar eclipse

318
00:13:58,958 --> 00:14:04,748
that goes across America will come on

319
00:14:01,568 --> 00:14:06,849
August 21st so Monday August 21st there

320
00:14:04,749 --> 00:14:09,879
will be a tough you haven't paid any

321
00:14:06,850 --> 00:14:12,069
attention for the past five years there

322
00:14:09,879 --> 00:14:15,999
will be a total solar eclipse that

323
00:14:12,068 --> 00:14:19,360
starts around 10:15 a.m. out in Oregon

324
00:14:15,999 --> 00:14:22,689
and passes through South Carolina

325
00:14:19,360 --> 00:14:26,949
somewhere around of what is that 3:00

326
00:14:22,688 --> 00:14:28,808
p.m. okay and if you're in the path of

327
00:14:26,948 --> 00:14:31,299
totality you will see the total solar

328
00:14:28,808 --> 00:14:33,759

eclipse however if you are anywhere

329

00:14:31,299 --> 00:14:38,289

within North America you're pretty much

330

00:14:33,759 --> 00:14:41,350

going to get a 60 70 80 90 percent

331

00:14:38,289 --> 00:14:43,208

eclipse okay there are a lots of tools

332

00:14:41,350 --> 00:14:45,278

out there on the web I don't need to go

333

00:14:43,208 --> 00:14:47,828

through them we gave a complete talk on

334

00:14:45,278 --> 00:14:49,539

January go back and watch that talk and

335

00:14:47,828 --> 00:14:52,328

you'll have all the details if you want

336

00:14:49,539 --> 00:14:53,620

they are thing if you are not in the

337

00:14:52,328 --> 00:14:55,750

path note if you're in the path of

338

00:14:53,620 --> 00:14:57,970

totality there are these tools that will

339

00:14:55,750 --> 00:15:00,399

tell you you know when it starts when

340

00:14:57,970 --> 00:15:02,079

it's maximum when it ends alright and so

341

00:15:00,399 --> 00:15:04,928

in Salem Oregon they're gonna have them

342

00:15:02,078 --> 00:15:07,198

one minute and 55 second total solar

343
00:15:04,928 --> 00:15:10,778
eclipse if you stay here in Baltimore

344
00:15:07,198 --> 00:15:13,299
you will have not a total eclipse you'll

345
00:15:10,778 --> 00:15:16,870
have a partial eclipse about 80%

346
00:15:13,299 --> 00:15:20,349
obscured and its maximum will be at 243

347
00:15:16,870 --> 00:15:23,198
in the afternoon okay lots and lots of

348
00:15:20,350 --> 00:15:25,300
cool tools out there lots and lots of

349
00:15:23,198 --> 00:15:27,878
cool websites I advise you to take

350
00:15:25,299 --> 00:15:30,250
advantage of them before and alright the

351
00:15:27,879 --> 00:15:34,300
one thing that I always have to say for

352
00:15:30,250 --> 00:15:38,440
every audience is protect your

353
00:15:34,299 --> 00:15:39,879
okay do not use sunglasses do not use a

354
00:15:38,440 --> 00:15:42,070
mylar balloon

355
00:15:39,879 --> 00:15:44,590
do not lose something your uncle George

356
00:15:42,070 --> 00:15:47,650
told you all this is safe right no you

357
00:15:44,590 --> 00:15:51,160
want certified solar viewing glasses

358
00:15:47,649 --> 00:15:53,289
okay they must be certified to protect

359
00:15:51,159 --> 00:15:54,759
your eyes all right I was down at the

360
00:15:53,289 --> 00:15:56,620
beach this weekend talking with somebody

361
00:15:54,759 --> 00:15:58,419
about it I said take a look at the Sun

362
00:15:56,620 --> 00:16:00,750
right now how long can you look at that

363
00:15:58,419 --> 00:16:03,069
before it starts to hurt your eyes okay

364
00:16:00,750 --> 00:16:04,960
this is what you need to do if you want

365
00:16:03,070 --> 00:16:06,790
to stare at the Sun and watch that total

366
00:16:04,960 --> 00:16:09,009
solar eclipse or partial eclipse you

367
00:16:06,789 --> 00:16:10,860
need something that really blocks the

368
00:16:09,009 --> 00:16:13,149
light so that you don't hurt your eyes

369
00:16:10,860 --> 00:16:14,680
and after he stared the Sun for about

370
00:16:13,149 --> 00:16:17,230
four seconds he finally he got the

371

00:16:14,679 --> 00:16:18,729
picture oh yeah okay it's kept seeing

372
00:16:17,230 --> 00:16:21,940
the Sun for about three about thirty

373
00:16:18,730 --> 00:16:25,360
seconds afterwards right so you want

374
00:16:21,940 --> 00:16:26,890
Eclipse shades okay whenever any part of

375
00:16:25,360 --> 00:16:28,810
the Sun is visible you want to be

376
00:16:26,889 --> 00:16:31,210
wearing them if you will happen to get

377
00:16:28,809 --> 00:16:33,579
into totality and you and you and and

378
00:16:31,210 --> 00:16:35,350
during the few minutes of totality then

379
00:16:33,580 --> 00:16:37,420
you can take them off and look at the

380
00:16:35,350 --> 00:16:38,680
corona and actually I just suggest you

381
00:16:37,419 --> 00:16:40,479
do because you keep them on during

382
00:16:38,679 --> 00:16:41,799
totality you're not gonna see much all

383
00:16:40,480 --> 00:16:44,649
right you'll need to take them off

384
00:16:41,799 --> 00:16:46,299
during totality but once totality stops

385
00:16:44,649 --> 00:16:49,240

put them back on okay

386

00:16:46,299 --> 00:16:51,219

protect your eyes they are available

387

00:16:49,240 --> 00:16:54,149

online at lots of different places and

388

00:16:51,220 --> 00:16:56,740

they're only a couple bucks yes

389

00:16:54,149 --> 00:17:00,399

researchers the other day most of the

390

00:16:56,740 --> 00:17:05,440

sites are sold okay so it's too late

391

00:17:00,399 --> 00:17:06,819

forget it you're done 2024 because we're

392

00:17:05,440 --> 00:17:09,400

gonna have another total solar eclipse

393

00:17:06,819 --> 00:17:10,838

through America in 2024 this doesn't go

394

00:17:09,400 --> 00:17:13,839

coast-to-coast it comes up through

395

00:17:10,838 --> 00:17:16,059

Mexico goes across Cleveland and out

396

00:17:13,838 --> 00:17:18,429

through Nova Scotia I believe so alright

397

00:17:16,059 --> 00:17:19,958

so if you didn't buy them now buy the

398

00:17:18,430 --> 00:17:21,100

next year because you need them and

399

00:17:19,959 --> 00:17:28,089

you'll need them again in seven years

400
00:17:21,099 --> 00:17:31,829
okay kid they just get it something

401
00:17:28,088 --> 00:17:31,829
simple like you took up a piece of paper

402
00:17:36,298 --> 00:17:41,798
if you don't have Eclipse glasses you

403
00:17:39,429 --> 00:17:44,320
can't use a pinhole camera and you know

404
00:17:41,798 --> 00:17:46,929
project the project the image of it onto

405
00:17:44,319 --> 00:17:49,509
a piece of white paper okay and that

406
00:17:46,929 --> 00:17:51,730
worked extremely well too I remember I

407
00:17:49,509 --> 00:17:53,618
was up in Massachusetts when I was a kid

408
00:17:51,730 --> 00:17:56,220
and we did pinhole cameras we didn't

409
00:17:53,618 --> 00:17:56,220
have Eclipse glasses

410
00:17:56,278 --> 00:18:04,358
I didn't know about that when I was a

411
00:18:01,538 --> 00:18:06,638
kid yes you can use pinhole projectors

412
00:18:04,358 --> 00:18:09,009
and there are other ways to project the

413
00:18:06,638 --> 00:18:11,319
image again lots of websites out there

414
00:18:09,009 --> 00:18:11,950
take advantage of it just to take care

415
00:18:11,319 --> 00:18:15,548
of your eyes

416
00:18:11,950 --> 00:18:19,389
all right so that is our news and now we

417
00:18:15,548 --> 00:18:21,069
go to our featured speaker tonight as I

418
00:18:19,388 --> 00:18:24,579
said I'm excited to hear this

419
00:18:21,069 --> 00:18:26,589
Courtney McManus is an expert at things

420
00:18:24,579 --> 00:18:30,099
that you don't see except for in movies

421
00:18:26,589 --> 00:18:32,249
I guess in Mission Control she got her

422
00:18:30,099 --> 00:18:36,638
degree in aeronautical and astronautical

423
00:18:32,249 --> 00:18:38,499
engineering from Purdue and then she

424
00:18:36,638 --> 00:18:40,658
went to one of the most famous places of

425
00:18:38,499 --> 00:18:42,519
all Johnson Space Center worked in

426
00:18:40,659 --> 00:18:44,470
Mission Control a little bit on the

427
00:18:42,519 --> 00:18:47,649
shuttle program but mostly on the

428

00:18:44,470 --> 00:18:50,649
International Space Station we are very

429
00:18:47,648 --> 00:18:56,168
lucky we stole her got her to come here

430
00:18:50,648 --> 00:18:59,199
three years ago where she is in a title

431
00:18:56,169 --> 00:19:02,619
that I can't remember systems

432
00:18:59,200 --> 00:19:07,359
integration and test engineer see I knew

433
00:19:02,618 --> 00:19:08,709
I'd remember and we one of the things

434
00:19:07,358 --> 00:19:11,408
I'm sure she'll tell you is that we have

435
00:19:08,710 --> 00:19:13,629
the missions Operations Center for the

436
00:19:11,409 --> 00:19:16,299
James Webb Space Telescope upstairs and

437
00:19:13,628 --> 00:19:18,398
so jst we run from here Hubble is being

438
00:19:16,298 --> 00:19:20,769
run from Goddard Space Flight Center so

439
00:19:18,398 --> 00:19:24,189
people like Courtney are incredibly

440
00:19:20,769 --> 00:19:25,929
important for our future missions and

441
00:19:24,190 --> 00:19:28,419
for Courtney that gentleman right there

442
00:19:25,929 --> 00:19:30,038

is important for her future mission

443

00:19:28,419 --> 00:19:33,278
because she tells me she's getting

444

00:19:30,038 --> 00:19:35,408
married in one month okay so ladies and

445

00:19:33,278 --> 00:19:39,380
gentlemen while she's still single let's

446

00:19:35,409 --> 00:19:46,210
hear for Courtney McManus

447

00:19:39,380 --> 00:20:04,160
[Applause]

448

00:19:46,210 --> 00:20:07,460
hi everybody can you hear me okay haha

449

00:20:04,160 --> 00:20:09,470
success alright so as Frank said my name

450

00:20:07,460 --> 00:20:12,829
is Courtney McManus and I'm here to talk

451

00:20:09,470 --> 00:20:14,720
to you about what it takes to make space

452

00:20:12,829 --> 00:20:17,619
missions happen kind of the stuff behind

453

00:20:14,720 --> 00:20:20,450
the scenes so before I go into anything

454

00:20:17,619 --> 00:20:22,000
has anyone here seen the movie Apollo 13

455

00:20:20,450 --> 00:20:24,049
raise your hand

456

00:20:22,000 --> 00:20:25,759
excellent this will make it much easier

457
00:20:24,049 --> 00:20:27,529
for you guys to have a frame of

458
00:20:25,759 --> 00:20:32,629
reference if you haven't don't worry

459
00:20:27,529 --> 00:20:35,299
I'll guide you along so hi my name is

460
00:20:32,630 --> 00:20:36,890
Courtney like I said if you have any

461
00:20:35,299 --> 00:20:38,990
questions at any point feel free to ask

462
00:20:36,890 --> 00:20:42,770
otherwise hold them to the end and we'll

463
00:20:38,990 --> 00:20:47,750
we'll take them then I have a secret for

464
00:20:42,769 --> 00:20:50,210
you guys I'm not an astronomer so you

465
00:20:47,750 --> 00:20:51,319
guys might know more about astronomy

466
00:20:50,210 --> 00:20:54,470
stuff than I do

467
00:20:51,319 --> 00:20:57,079
having come to these lectures a lot the

468
00:20:54,470 --> 00:20:59,870
topic for the talk next month the blue

469
00:20:57,079 --> 00:21:02,179
variable stuff I don't really know any

470
00:20:59,869 --> 00:21:05,479
of that I know what a photon is for the

471
00:21:02,180 --> 00:21:08,000
most part and I know what it takes to

472
00:21:05,480 --> 00:21:11,180
make all of the stuff the astronomers

473
00:21:08,000 --> 00:21:13,069
want happen but I'm I'm not an

474
00:21:11,180 --> 00:21:15,259
astronomer at all

475
00:21:13,069 --> 00:21:18,289
right now I am a systems integration and

476
00:21:15,259 --> 00:21:21,470
test engineer for the James Webb Space

477
00:21:18,289 --> 00:21:22,789
Telescope so you guys probably know the

478
00:21:21,470 --> 00:21:23,690
James Webb Space Telescope's and

479
00:21:22,789 --> 00:21:25,940
development right now

480
00:21:23,690 --> 00:21:27,680
parts of it are down in Houston parts of

481
00:21:25,940 --> 00:21:29,509
it are out in California the Mission

482
00:21:27,680 --> 00:21:31,190
Operations Center is being developed and

483
00:21:29,509 --> 00:21:34,400
designed here

484
00:21:31,190 --> 00:21:36,410
my job as a test engineer is basically

485

00:21:34,400 --> 00:21:39,170
to take stuff that people work really

486
00:21:36,410 --> 00:21:40,640
really hard on and try to break it and I

487
00:21:39,170 --> 00:21:42,080
hope that I don't break it because

488
00:21:40,640 --> 00:21:45,140
they've usually done their job really

489
00:21:42,079 --> 00:21:46,879
well but sometimes we catch little

490
00:21:45,140 --> 00:21:50,210
errors that might happen and we try to

491
00:21:46,880 --> 00:21:51,680
do that before it gets into space so

492
00:21:50,210 --> 00:21:52,470
that we can fix everything before it

493
00:21:51,680 --> 00:21:55,289
goes up there

494
00:21:52,470 --> 00:21:57,059
so that's what I do right now but I'm

495
00:21:55,289 --> 00:21:59,759
going to talk to you about what I used

496
00:21:57,059 --> 00:22:01,799
to do when I was a flight controller

497
00:21:59,759 --> 00:22:04,680
with the International Space Station

498
00:22:01,799 --> 00:22:07,559
down in Houston this is actually a

499
00:22:04,680 --> 00:22:11,549

picture of me that's me that blur right

500

00:22:07,559 --> 00:22:14,309

there working on console and Mission

501

00:22:11,549 --> 00:22:16,529

Control this was on NASA television my

502

00:22:14,309 --> 00:22:19,139

mom took this screen shot to prove to my

503

00:22:16,529 --> 00:22:20,430

grandmother that I was in there it

504

00:22:19,140 --> 00:22:23,580

really could be anybody but that's

505

00:22:20,430 --> 00:22:25,860

definitely me and here's a picture of me

506

00:22:23,579 --> 00:22:29,639

really excited next to a Soyuz capsule

507

00:22:25,859 --> 00:22:31,679

which is what the Russians use to send a

508

00:22:29,640 --> 00:22:33,420

tour cosmonauts into space and we also

509

00:22:31,680 --> 00:22:35,880

hitch rides on there every now and then

510

00:22:33,420 --> 00:22:37,800

to send astronauts up into space too so

511

00:22:35,880 --> 00:22:40,770

I got to be next to one and it was

512

00:22:37,799 --> 00:22:42,000

really cool so I'm gonna talk to you

513

00:22:40,769 --> 00:22:47,430

about my time working as a flight

514
00:22:42,000 --> 00:22:52,200
controller with ISS this is the ISS this

515
00:22:47,430 --> 00:22:55,259
is Isis it is not the ISS this is the

516
00:22:52,200 --> 00:22:57,930
ISS sometimes people get confused when I

517
00:22:55,259 --> 00:23:00,960
talk quickly sounds like I'm saying one

518
00:22:57,930 --> 00:23:02,430
thing but I'm talking about the ISS so

519
00:23:00,960 --> 00:23:05,640
the International Space Station where

520
00:23:02,430 --> 00:23:09,870
the ISS is orbiting up in space about

521
00:23:05,640 --> 00:23:11,820
400 miles up there it kind of fluctuates

522
00:23:09,869 --> 00:23:14,250
a little bit right now we have six

523
00:23:11,819 --> 00:23:15,629
people I think on board the ISS they

524
00:23:14,250 --> 00:23:18,359
definitely should check that before I

525
00:23:15,630 --> 00:23:19,950
started talking but usually there's a

526
00:23:18,359 --> 00:23:22,229
crew of six people from various

527
00:23:19,950 --> 00:23:24,630
countries up on the ISS working and

528
00:23:22,230 --> 00:23:26,819
living in space all the time

529
00:23:24,630 --> 00:23:28,830
doing science experiments learning how

530
00:23:26,819 --> 00:23:30,689
our bodies adapt to space making it so

531
00:23:28,829 --> 00:23:35,669
we can do longer-term spaceflight

532
00:23:30,690 --> 00:23:38,220
missions out to Mars etc so does anyone

533
00:23:35,670 --> 00:23:42,200
know where Mission Control for the ISS

534
00:23:38,220 --> 00:23:44,430
is shout it out if you know I heard it

535
00:23:42,200 --> 00:23:45,840
Houston yes you probably have heard the

536
00:23:44,430 --> 00:23:47,519
line houston we have a problem

537
00:23:45,839 --> 00:23:49,500
that's because they were talking to

538
00:23:47,519 --> 00:23:52,859
Houston not just like some guy in in

539
00:23:49,500 --> 00:23:55,349
Houston it's the actual city so this is

540
00:23:52,859 --> 00:23:57,569
the very beautiful building where the

541
00:23:55,349 --> 00:24:00,119
Mission Control Center in Houston is

542

00:23:57,569 --> 00:24:02,279
located it's called the Christopher C

543
00:24:00,119 --> 00:24:04,109
Kraft jr. Mission Control Center named

544
00:24:02,279 --> 00:24:05,579
after Chris Kraft one of the

545
00:24:04,109 --> 00:24:08,369
names actually Christopher Columbus

546
00:24:05,579 --> 00:24:10,500
craft which is I don't know if I'd want

547
00:24:08,369 --> 00:24:12,119
that name but it's named after him he's

548
00:24:10,500 --> 00:24:14,308
one of the founders of Mission Control

549
00:24:12,119 --> 00:24:16,289
there's a whole theory out there that he

550
00:24:14,308 --> 00:24:18,269
helped to develop on what it takes to be

551
00:24:16,289 --> 00:24:20,269
a really solid Mission Control flight

552
00:24:18,269 --> 00:24:22,470
flight director and flight controller

553
00:24:20,269 --> 00:24:24,779
some really interesting stuff out him

554
00:24:22,470 --> 00:24:28,019
out there on him if you're interested in

555
00:24:24,779 --> 00:24:30,899
more detail after I finished my talk I

556
00:24:28,019 --> 00:24:32,819

suggest looking up Chris Craft anyway so

557

00:24:30,900 --> 00:24:34,890

this is a beautiful building there are

558

00:24:32,819 --> 00:24:37,048

no windows when you're inside it's very

559

00:24:34,890 --> 00:24:39,059

dark and very cold

560

00:24:37,048 --> 00:24:41,970

I was always freezing in Mission Control

561

00:24:39,058 --> 00:24:43,379

but that's it's actually better that

562

00:24:41,970 --> 00:24:45,240

there are no windows because then you

563

00:24:43,380 --> 00:24:48,179

can't tell that it's 3:00 in the morning

564

00:24:45,240 --> 00:24:50,429

and you're sitting at work because the

565

00:24:48,179 --> 00:24:52,798

Mission Control Center is staffed 24/7

566

00:24:50,429 --> 00:24:56,280

365 there's a person who has to see them

567

00:24:52,798 --> 00:24:56,759

they're on Thanksgiving and work at 3:00

568

00:24:56,279 --> 00:24:58,950

in the morning

569

00:24:56,759 --> 00:25:00,509

but usually people are nice and bring

570

00:24:58,950 --> 00:25:02,610

them food there's always food in Mission

571
00:25:00,509 --> 00:25:04,859
Control a fun fact about this building

572
00:25:02,609 --> 00:25:06,779
is anytime you see a flag flying out on

573
00:25:04,859 --> 00:25:10,918
the top it means there is someone in

574
00:25:06,779 --> 00:25:12,450
space it used to make more sense during

575
00:25:10,919 --> 00:25:15,150
times when we just had the shuttle

576
00:25:12,450 --> 00:25:16,259
flying because the shuttle wasn't up

577
00:25:15,150 --> 00:25:17,880
there all the time it would happen

578
00:25:16,259 --> 00:25:19,200
intermittently so you can look and say

579
00:25:17,880 --> 00:25:20,520
oh there's a shuttle mission cool

580
00:25:19,200 --> 00:25:21,660
someone's up there but now it's always

581
00:25:20,519 --> 00:25:23,250
flying because there's always someone

582
00:25:21,660 --> 00:25:26,669
Manning the International Space Station

583
00:25:23,250 --> 00:25:28,919
so once you go inside that building

584
00:25:26,669 --> 00:25:31,110
there are these really fancy looking

585
00:25:28,919 --> 00:25:32,880
doors that it's really hard to get

586
00:25:31,109 --> 00:25:35,849
through unless you're authorized so

587
00:25:32,880 --> 00:25:37,890
don't ever try it's really tough there's

588
00:25:35,849 --> 00:25:40,139
lots of sirens and guards and such but

589
00:25:37,890 --> 00:25:42,059
once you get through those doors you go

590
00:25:40,140 --> 00:25:46,350
through some catacombs a little ways and

591
00:25:42,058 --> 00:25:47,940
then you get to this room here in the

592
00:25:46,349 --> 00:25:49,349
Mission Control Building they're a

593
00:25:47,940 --> 00:25:51,929
handful of different Mission Control

594
00:25:49,349 --> 00:25:52,859
centers this one is for the it's the

595
00:25:51,929 --> 00:25:54,509
flight control room for the

596
00:25:52,859 --> 00:25:56,039
International Space Station and I'm

597
00:25:54,509 --> 00:25:59,190
going to talk to you about what all of

598
00:25:56,039 --> 00:26:03,859
this is who all these people are what

599

00:25:59,190 --> 00:26:03,860
they do what it means stuff like that

600
00:26:04,548 --> 00:26:11,129
but first I want to show you a little

601
00:26:08,279 --> 00:26:13,259
intro video for to get your head in the

602
00:26:11,130 --> 00:26:15,210
right space for what Mission Control is

603
00:26:13,259 --> 00:26:17,759
I thought about showing a clip from

604
00:26:15,210 --> 00:26:19,769
Apollo 13 and then I realized that there

605
00:26:17,759 --> 00:26:22,529
like actual stuff that happened and was

606
00:26:19,769 --> 00:26:28,410
filmed so be way better if I showed you

607
00:26:22,529 --> 00:26:32,490
a clip from an actual Apollo mission

608
00:26:28,410 --> 00:26:34,019
it's way better than Apollo 13 so in

609
00:26:32,490 --> 00:26:36,750
this video this is a really excellent

610
00:26:34,019 --> 00:26:39,240
video of a small snippet of when they

611
00:26:36,750 --> 00:26:41,430
were landing the Apollo 11 landing in

612
00:26:39,240 --> 00:26:45,539
this video you'll see Jean Krantz a

613
00:26:41,430 --> 00:26:47,430

flight director and you'll see a handful

614

00:26:45,539 --> 00:26:49,470

of other Mission Control people that are

615

00:26:47,430 --> 00:26:51,210

in there you'll also see oh gosh I don't

616

00:26:49,470 --> 00:26:53,220

remember what his name is but you'll see

617

00:26:51,210 --> 00:26:56,009

the Capcom or the capsule communicator

618

00:26:53,220 --> 00:26:58,170

who's the person who's talking to the

619

00:26:56,009 --> 00:27:00,690

capsule up in space

620

00:26:58,170 --> 00:27:02,160

you'll hear two different voice loops is

621

00:27:00,690 --> 00:27:03,299

what they're called in this in this film

622

00:27:02,160 --> 00:27:05,100

you'll hear what's called the flight

623

00:27:03,299 --> 00:27:06,899

loop which is where how the flight

624

00:27:05,099 --> 00:27:09,299

director talks to all the other flight

625

00:27:06,900 --> 00:27:11,100

controllers and you'll also hear the

626

00:27:09,299 --> 00:27:13,379

loop on which the capsule communicator

627

00:27:11,099 --> 00:27:15,059

talked to the spacecraft so you'll hear

628
00:27:13,380 --> 00:27:17,520
both of them so you're going to hear

629
00:27:15,059 --> 00:27:20,089
them go through a sequence of the flight

630
00:27:17,519 --> 00:27:22,650
director pulling all of the flight

631
00:27:20,089 --> 00:27:25,319
controllers as to whether or not the

632
00:27:22,650 --> 00:27:29,100
systems and the people are ready for at

633
00:27:25,319 --> 00:27:37,619
the actual moon landing so I hope this

634
00:27:29,099 --> 00:27:39,000
works it's gonna be really cool okay

635
00:27:37,619 --> 00:27:43,669
I'll fly controllers go/no-go for

636
00:27:39,000 --> 00:27:46,970
landing retro alright alright so control

637
00:27:43,670 --> 00:27:50,960
sir jet go Capcom work go for landing

638
00:27:46,970 --> 00:27:50,960
Houston you're go for landing over

639
00:28:03,079 --> 00:28:15,539
okay we're go we're go flight photo

640
00:28:07,200 --> 00:28:18,890
right on real watch agrees Roger it

641
00:28:15,539 --> 00:28:22,319
looks okay we're on hi Roger

642
00:28:18,890 --> 00:28:24,150
alright well so it the way they have the

643
00:28:22,319 --> 00:28:25,799
video set up is so that in the left

644
00:28:24,150 --> 00:28:27,509
audio channel you hear one in the right

645
00:28:25,799 --> 00:28:29,579
audio channel you hear the other so it

646
00:28:27,509 --> 00:28:30,359
must have not been both channels coming

647
00:28:29,579 --> 00:28:35,429
through but that's early

648
00:28:30,359 --> 00:28:38,009
fine you guys heard at least the flight

649
00:28:35,430 --> 00:28:38,880
director loop which was pretty cool but

650
00:28:38,009 --> 00:28:43,259
you could hear

651
00:28:38,880 --> 00:28:45,510
I suggest go look it up after this talk

652
00:28:43,259 --> 00:28:53,879
not during it probably but after the

653
00:28:45,509 --> 00:28:55,079
talk oh gosh sorry excusing I'll ask my

654
00:28:53,880 --> 00:28:56,820
train of thought because I was gonna

655
00:28:55,079 --> 00:29:00,480
talk about the two audio channels and

656

00:28:56,819 --> 00:29:03,000
then there's only one so you wouldn't

657
00:29:00,480 --> 00:29:04,920
you when the Apollo 11 landed was

658
00:29:03,000 --> 00:29:06,930
landing on the moon there was an alarm

659
00:29:04,920 --> 00:29:09,930
that sounded on the spacecraft and you

660
00:29:06,930 --> 00:29:13,710
can in that it's called the 1201 alarm

661
00:29:09,930 --> 00:29:15,420
in that video clip in the audio you

662
00:29:13,710 --> 00:29:18,019
could hear the astronauts calling out

663
00:29:15,420 --> 00:29:21,000
the 1201 alarm and then you can hear the

664
00:29:18,019 --> 00:29:22,589
flight controllers talking amongst

665
00:29:21,000 --> 00:29:23,819
themselves saying oh it's an alarm we've

666
00:29:22,589 --> 00:29:25,319
seen before everything's fine we're

667
00:29:23,819 --> 00:29:27,869
still go flight and then flight tells

668
00:29:25,319 --> 00:29:29,309
the Capcom to tell the crew that they're

669
00:29:27,869 --> 00:29:30,779
still go to land and then the crew can

670
00:29:29,309 --> 00:29:33,619

still go to land and then the crew lands

671

00:29:30,779 --> 00:29:36,210

and you all know what happens after that

672

00:29:33,619 --> 00:29:38,459

so so that kind of puts into perspective

673

00:29:36,210 --> 00:29:40,380

a little bit of what has to happen in

674

00:29:38,460 --> 00:29:42,720

Mission Control to get things to go on

675

00:29:40,380 --> 00:29:44,370

so now I want to orient you a little bit

676

00:29:42,720 --> 00:29:46,440

to the flight control room of the

677

00:29:44,369 --> 00:29:48,419

International Space Station so the

678

00:29:46,440 --> 00:29:50,160

flight director sits right here in the

679

00:29:48,420 --> 00:29:53,610

middle of the room and the Capcom is

680

00:29:50,160 --> 00:29:55,110

right next to him or her but up here we

681

00:29:53,609 --> 00:29:56,369

have a couple of different pretty nifty

682

00:29:55,109 --> 00:29:58,859

things that I want to point out to you

683

00:29:56,369 --> 00:30:00,869

guys we have this thing right here in

684

00:29:58,859 --> 00:30:03,959

the middle called the bird's eye view

685
00:30:00,869 --> 00:30:07,619
which is a map of the world that shows

686
00:30:03,960 --> 00:30:10,350
where the ISS is at any point in

687
00:30:07,619 --> 00:30:12,719
time it's kind of hard sitting on the

688
00:30:10,349 --> 00:30:14,129
ground to visualize where in space it

689
00:30:12,720 --> 00:30:16,350
might be they just throw it up in the

690
00:30:14,130 --> 00:30:18,120
middle so everyone knows it also shows

691
00:30:16,349 --> 00:30:19,889
that you can't see very well in this

692
00:30:18,119 --> 00:30:22,199
picture but it also shows the dark and

693
00:30:19,890 --> 00:30:23,550
the light so it shows when the ISS is

694
00:30:22,200 --> 00:30:26,640
going into eclipse and when it's going

695
00:30:23,549 --> 00:30:28,079
to be in insulation or in sunshine it

696
00:30:26,640 --> 00:30:29,670
shows where some of the communications

697
00:30:28,079 --> 00:30:31,799
satellites are so we know which

698
00:30:29,670 --> 00:30:34,680
satellite the ISS is talking to at any

699
00:30:31,799 --> 00:30:37,919
given time it also can show things like

700
00:30:34,680 --> 00:30:39,720
the attitude and orientation of the ISS

701
00:30:37,920 --> 00:30:41,400
right here which is important when

702
00:30:39,720 --> 00:30:43,829
you're thinking about where your

703
00:30:41,400 --> 00:30:44,390
antennas are pointing or if you want to

704
00:30:43,829 --> 00:30:46,519
take an OP

705
00:30:44,390 --> 00:30:47,750
privation of a certain point on earth or

706
00:30:46,519 --> 00:30:49,910
you want the astronauts to go take a

707
00:30:47,750 --> 00:30:51,730
picture of a volcano erupting you need

708
00:30:49,910 --> 00:30:54,529
to know which window to go look out of

709
00:30:51,730 --> 00:30:57,769
then you have camera feeds coming from

710
00:30:54,529 --> 00:30:59,509
either inside or outside the ISS on

711
00:30:57,769 --> 00:31:01,579
these three screens here and on this one

712
00:30:59,509 --> 00:31:04,129
here and kind of on the right hand side

713

00:31:01,579 --> 00:31:06,619
is the caution and warning screen so at

714
00:31:04,130 --> 00:31:07,940
any time there might be a handful of

715
00:31:06,619 --> 00:31:09,949
things that aren't going the way they're

716
00:31:07,940 --> 00:31:12,200
supposed to on the different systems and

717
00:31:09,950 --> 00:31:13,490
the ifs and the various flight

718
00:31:12,200 --> 00:31:16,279
controllers need to be aware of it

719
00:31:13,490 --> 00:31:17,870
they're all aware of it in some degree

720
00:31:16,279 --> 00:31:19,759
for their own systems but you might need

721
00:31:17,869 --> 00:31:23,059
to know something about another system

722
00:31:19,759 --> 00:31:24,740
so that's thrown up here it's actually

723
00:31:23,059 --> 00:31:27,769
not great that there's red and yellow

724
00:31:24,740 --> 00:31:29,150
right here because that means something

725
00:31:27,769 --> 00:31:31,910
not good is happening so I don't know

726
00:31:29,150 --> 00:31:34,910
when this picture was taken but it's not

727
00:31:31,910 --> 00:31:39,350

good it's not good to see red in Mission

728

00:31:34,910 --> 00:31:42,380

Control just as a general rule so let's

729

00:31:39,349 --> 00:31:44,689

see this was a video I showed you so

730

00:31:42,380 --> 00:31:46,730

we'll switch back to this picture here

731

00:31:44,690 --> 00:31:47,900

so I want to jump in and I want to talk

732

00:31:46,730 --> 00:31:51,110

to you guys about what each one of these

733

00:31:47,900 --> 00:31:52,759

console positions do and then at the end

734

00:31:51,109 --> 00:31:54,519

of talking about ISS I'll jump in a

735

00:31:52,759 --> 00:31:57,379

little bit to what the different

736

00:31:54,519 --> 00:31:59,599

consoles and experts will be for the

737

00:31:57,380 --> 00:32:01,820

James Webb Space Telescope so first I

738

00:31:59,599 --> 00:32:04,250

want to talk about the flight director

739

00:32:01,819 --> 00:32:06,139

and Capcom that's who you guys saw in

740

00:32:04,250 --> 00:32:07,809

the video it's who you might be most

741

00:32:06,140 --> 00:32:11,330

familiar with from the movie Apollo 13

742
00:32:07,809 --> 00:32:15,019
things like that so the flight director

743
00:32:11,329 --> 00:32:18,589
is totally in charge of everything ever

744
00:32:15,019 --> 00:32:20,029
on the ISS period there are a handful of

745
00:32:18,589 --> 00:32:21,230
Mission Control centers I forgot to

746
00:32:20,029 --> 00:32:23,149
mention that there's a Mission Control

747
00:32:21,230 --> 00:32:26,329
Center in Moscow there's a Mission

748
00:32:23,150 --> 00:32:29,840
Control Center in Germany there's one in

749
00:32:26,329 --> 00:32:31,819
Japan there's one in Houston there's

750
00:32:29,839 --> 00:32:33,589
actually a payload control center in

751
00:32:31,819 --> 00:32:35,359
Alabama so there's a handful of

752
00:32:33,589 --> 00:32:37,069
different control centers all over the

753
00:32:35,359 --> 00:32:38,750
place and each one of those control

754
00:32:37,069 --> 00:32:40,519
centers has their own flight director

755
00:32:38,750 --> 00:32:43,250
but the flight director who's in Houston

756
00:32:40,519 --> 00:32:45,500
is the number one person in charge he or

757
00:32:43,250 --> 00:32:48,680
she makes the final call on everything

758
00:32:45,500 --> 00:32:52,190
that happens on the ISS so you may

759
00:32:48,680 --> 00:32:53,570
recognize Ed Harris from the movie

760
00:32:52,190 --> 00:32:56,799
Apollo 13 he was a flight director

761
00:32:53,569 --> 00:32:58,869
playing this guy Gene Kranz who you saw

762
00:32:56,799 --> 00:33:01,029
video before Jane Krantz is a really

763
00:32:58,869 --> 00:33:03,279
cool guy if you haven't heard about him

764
00:33:01,029 --> 00:33:04,660
before I definitely look him up I saw

765
00:33:03,279 --> 00:33:07,480
him once on an airplane and I got really

766
00:33:04,660 --> 00:33:09,850
excited flying back to Houston it was

767
00:33:07,480 --> 00:33:12,430
very cool for me but I was cool on the

768
00:33:09,849 --> 00:33:14,619
outside like oh hey how's it going on

769
00:33:12,430 --> 00:33:18,850
the inside I was like oh my god this is

770

00:33:14,619 --> 00:33:21,369
so cool um so the flight director like I

771
00:33:18,849 --> 00:33:24,569
said is in charge of everything they he

772
00:33:21,369 --> 00:33:28,899
he or she is the person in the room who

773
00:33:24,569 --> 00:33:30,220
has final say even if the president

774
00:33:28,900 --> 00:33:32,200
called and wanted something to happen on

775
00:33:30,220 --> 00:33:33,730
the ISS it couldn't happen unless the

776
00:33:32,200 --> 00:33:38,410
flight director said yes it can happen

777
00:33:33,730 --> 00:33:41,230
so kind of give you an idea so Capcom is

778
00:33:38,410 --> 00:33:43,000
the capsule communicator probably the

779
00:33:41,230 --> 00:33:45,220
most famous Capcom you guys have ever

780
00:33:43,000 --> 00:33:49,450
heard of is the actor commonly known as

781
00:33:45,220 --> 00:33:53,259
oh yeah that guy whose name I don't

782
00:33:49,450 --> 00:33:54,190
actually remember Garrett Gary that's

783
00:33:53,259 --> 00:33:58,089
right

784
00:33:54,190 --> 00:34:00,610

so he played like the Capcom in the

785

00:33:58,089 --> 00:34:02,169
movie Apollo 13 but a real-life Capcom

786

00:34:00,609 --> 00:34:04,899
can be seen here

787

00:34:02,170 --> 00:34:07,240
here this gentleman right here is the

788

00:34:04,900 --> 00:34:08,800
current Capcom not current like now but

789

00:34:07,240 --> 00:34:10,090
current when the picture was taken this

790

00:34:08,800 --> 00:34:12,730
is the current Capcom in the flight

791

00:34:10,090 --> 00:34:13,990
director sitting in Mission Control the

792

00:34:12,730 --> 00:34:15,969
Capcom and the flight director always

793

00:34:13,989 --> 00:34:18,849
sitting next to each other and the

794

00:34:15,969 --> 00:34:22,928
Capcom is for the most part the only

795

00:34:18,849 --> 00:34:25,059
person that can talk to the astronauts

796

00:34:22,929 --> 00:34:28,809
in space this was especially important

797

00:34:25,059 --> 00:34:30,610
in apollo gemini and the space shuttle

798

00:34:28,809 --> 00:34:32,259
it's a little less important now at the

799

00:34:30,610 --> 00:34:33,809

ISS since we have people up there all

800

00:34:32,260 --> 00:34:35,800

the time working on different

801

00:34:33,809 --> 00:34:38,619

experiments and stuff like that you want

802

00:34:35,800 --> 00:34:41,110

different specialists to be able to talk

803

00:34:38,619 --> 00:34:43,089

to them but anytime there is a dynamic

804

00:34:41,110 --> 00:34:44,890

operation happening and especially in

805

00:34:43,090 --> 00:34:46,510

the days of the shuttle Capcom was the

806

00:34:44,889 --> 00:34:47,230

only person who could talk to the two

807

00:34:46,510 --> 00:34:49,780

astronauts

808

00:34:47,230 --> 00:34:51,699

Capcom was generally a former astronaut

809

00:34:49,780 --> 00:34:54,970

themselves and the reason that this is

810

00:34:51,699 --> 00:34:57,159

is so there's only one voice that the

811

00:34:54,969 --> 00:34:58,959

astronauts hear and they're not hearing

812

00:34:57,159 --> 00:34:59,559

all of the craziness that's happening on

813
00:34:58,960 --> 00:35:01,389
the ground

814
00:34:59,559 --> 00:35:03,579
the reason it's a former astronaut is

815
00:35:01,389 --> 00:35:05,679
because they generally know in this

816
00:35:03,579 --> 00:35:07,630
situation that's happening these are the

817
00:35:05,679 --> 00:35:09,219
things that I would want to know up in

818
00:35:07,630 --> 00:35:10,269
space and these are the things I need to

819
00:35:09,219 --> 00:35:14,769
hear

820
00:35:10,269 --> 00:35:17,139
to react to the situation so now it's

821
00:35:14,769 --> 00:35:18,460
not just astronauts but different

822
00:35:17,139 --> 00:35:20,440
specialists and stuff who can talk to

823
00:35:18,460 --> 00:35:28,809
the astronauts and acting as Capcom

824
00:35:20,440 --> 00:35:30,610
anesthesia yeah so there is a play

825
00:35:28,809 --> 00:35:32,650
director office if you didn't get a

826
00:35:30,610 --> 00:35:34,390
question it is what happens with 24/7

827

00:35:32,650 --> 00:35:36,670
coverage are there multiple is there a

828
00:35:34,389 --> 00:35:38,049
deputy that sort of thing so there are

829
00:35:36,670 --> 00:35:41,110
there's a flight director office that

830
00:35:38,050 --> 00:35:43,780
has I don't know how many but a whole

831
00:35:41,110 --> 00:35:45,400
cadre of flight directors so the on

832
00:35:43,780 --> 00:35:46,990
console flight director is the person

833
00:35:45,400 --> 00:35:48,880
who has the final authority the person

834
00:35:46,989 --> 00:35:51,849
who's in the room at the time there's

835
00:35:48,880 --> 00:35:55,180
also for every increment on the ISS

836
00:35:51,849 --> 00:35:58,839
that's when a new crew of three people

837
00:35:55,179 --> 00:36:00,279
flies up on the Soyuz that new group of

838
00:35:58,840 --> 00:36:01,809
three people is called an increment so

839
00:36:00,280 --> 00:36:03,460
forever increment there's a lead flight

840
00:36:01,809 --> 00:36:07,360
director and they're kind of the ones

841
00:36:03,460 --> 00:36:10,420

who oversee the activities from start to

842

00:36:07,360 --> 00:36:12,370

finish of the increment but with 24/7

843

00:36:10,420 --> 00:36:14,170

ops the flight director console is one

844

00:36:12,369 --> 00:36:16,359

of the one of the consoles that's

845

00:36:14,170 --> 00:36:17,950

staffed all the time there's always a

846

00:36:16,360 --> 00:36:20,410

flight director there's not always a

847

00:36:17,949 --> 00:36:22,359

Capcom like when the astronauts are

848

00:36:20,409 --> 00:36:23,769

sleeping cuz even though they're in

849

00:36:22,360 --> 00:36:25,780

space we still let them sleep eight

850

00:36:23,769 --> 00:36:27,699

hours a day in fact it's planned into

851

00:36:25,780 --> 00:36:29,530

their day they have to sleep eight hours

852

00:36:27,699 --> 00:36:31,779

they even get free times if they want

853

00:36:29,530 --> 00:36:33,250

free time they do that sometimes you get

854

00:36:31,780 --> 00:36:36,010

an astronaut like Peggy Whitson

855

00:36:33,250 --> 00:36:38,559

who recently broke records for most days

856
00:36:36,010 --> 00:36:40,800
in space she's so cool in her free time

857
00:36:38,559 --> 00:36:43,900
she would just do more stuff like

858
00:36:40,800 --> 00:36:45,519
there's a it's called a task list that

859
00:36:43,900 --> 00:36:47,470
they have for the astronauts to do as

860
00:36:45,519 --> 00:36:48,849
while they're on orbit so if they have a

861
00:36:47,469 --> 00:36:50,259
little bit of free time and maybe want

862
00:36:48,849 --> 00:36:52,089
to advance science or something they

863
00:36:50,260 --> 00:36:54,130
could do that Peggy Whitson works in the

864
00:36:52,090 --> 00:36:55,870
whole task list and we had to pull stuff

865
00:36:54,130 --> 00:36:58,269
from other task lists just to give her

866
00:36:55,869 --> 00:37:01,710
because she was so cool I saw her in an

867
00:36:58,269 --> 00:37:01,710
elevator once too it was really exciting

868
00:37:02,369 --> 00:37:07,950
anyways so the Capcom console is not

869
00:37:05,909 --> 00:37:10,259
staffed when the astronauts are asleep

870
00:37:07,949 --> 00:37:11,969
or maybe at some other times but the

871
00:37:10,260 --> 00:37:16,020
flight director console is always

872
00:37:11,969 --> 00:37:20,489
staffed so that brings me into the other

873
00:37:16,019 --> 00:37:24,989
consoles that are staffed 24/7 365 or

874
00:37:20,489 --> 00:37:30,929
366 we also staff on leap years we got

875
00:37:24,989 --> 00:37:32,459
ad Co Chronos ethos and Sparkman you

876
00:37:30,929 --> 00:37:36,269
should pay attention cuz there's gonna

877
00:37:32,460 --> 00:37:38,070
be a quiz and I'm going to talk about

878
00:37:36,269 --> 00:37:39,750
which each one of these do it won't

879
00:37:38,070 --> 00:37:41,490
surprise you to find out that each one

880
00:37:39,750 --> 00:37:41,880
of these names are acronyms because at

881
00:37:41,489 --> 00:37:44,429
NASA

882
00:37:41,880 --> 00:37:46,108
everyone loves acronyms even though some

883
00:37:44,429 --> 00:37:47,389
of them are a stretch and I'll show you

884

00:37:46,108 --> 00:37:52,139
in a second

885
00:37:47,389 --> 00:37:54,420
so ad Co is the attitude determination

886
00:37:52,139 --> 00:37:57,750
and control officer they are the people

887
00:37:54,420 --> 00:37:59,849
who determine and control the attitude

888
00:37:57,750 --> 00:38:03,088
for the International Space Station as

889
00:37:59,849 --> 00:38:05,940
you might guess so what does that mean

890
00:38:03,088 --> 00:38:07,828
much like an airplane can go this way in

891
00:38:05,940 --> 00:38:09,510
this way in this way the space station

892
00:38:07,829 --> 00:38:11,910
can also go this way in this way in this

893
00:38:09,510 --> 00:38:15,599
way but it also goes this way around the

894
00:38:11,909 --> 00:38:17,429
earth so the ADCO is the console in

895
00:38:15,599 --> 00:38:20,250
charge of making sure we know how the

896
00:38:17,429 --> 00:38:26,309
spacecraft is oriented and where they

897
00:38:20,250 --> 00:38:27,539
are in earth over Earth's orbit they you

898
00:38:26,309 --> 00:38:29,940

can think of them as kind of the ones

899

00:38:27,539 --> 00:38:31,349

who actually fly the ISS and that's what

900

00:38:29,940 --> 00:38:33,150

they'll tell you if you ever talk to an

901

00:38:31,349 --> 00:38:37,289

ad Co is that they're the ones who fly

902

00:38:33,150 --> 00:38:40,380

the ISS so we also have chromis and this

903

00:38:37,289 --> 00:38:42,269

is an example of one of the acronyms

904

00:38:40,380 --> 00:38:44,730

that's a little bit of a stretch they're

905

00:38:42,269 --> 00:38:48,539

the communications RF onboard network

906

00:38:44,730 --> 00:38:52,829

utilization specialist obviously and

907

00:38:48,539 --> 00:38:55,858

they utilize communications and RF

908

00:38:52,829 --> 00:38:58,740

onboard networks know they are in charge

909

00:38:55,858 --> 00:39:01,380

of the communication between the

910

00:38:58,739 --> 00:39:04,529

spacecraft and the ground there is a

911

00:39:01,380 --> 00:39:05,309

very video feed from the spacecraft on

912

00:39:04,530 --> 00:39:07,290

the ground let me out

913
00:39:05,309 --> 00:39:09,150
and the inside and they are in charge of

914
00:39:07,289 --> 00:39:10,920
the computers now this is a little bit

915
00:39:09,150 --> 00:39:13,500
of a misleading picture because they're

916
00:39:10,920 --> 00:39:14,849
not in charge of the computers such as

917
00:39:13,500 --> 00:39:17,670
laptops and stuff they're in charge of

918
00:39:14,849 --> 00:39:22,049
the computers that the ISS uses to talk

919
00:39:17,670 --> 00:39:24,329
to itself so all of the commands that we

920
00:39:22,050 --> 00:39:25,560
send up to the spacecraft get processed

921
00:39:24,329 --> 00:39:27,239
their computers and sent to the

922
00:39:25,559 --> 00:39:31,110
different subsystems like if you want to

923
00:39:27,239 --> 00:39:33,179
turn on a fan in one module you'd send

924
00:39:31,110 --> 00:39:34,890
up a command to turn on that fan these

925
00:39:33,179 --> 00:39:38,190
the computers that Chronos is in charge

926
00:39:34,889 --> 00:39:39,809
of is what take that command understands

927
00:39:38,190 --> 00:39:44,780
it and sends it to that fan to turn the

928
00:39:39,809 --> 00:39:48,170
fan on so that's how they utilize

929
00:39:44,780 --> 00:39:50,750
communications RF onboard and networks

930
00:39:48,170 --> 00:39:53,010
next we have ethos ethos the

931
00:39:50,750 --> 00:39:54,869
environmental and thermal operation

932
00:39:53,010 --> 00:39:57,690
system specialists they are the ones in

933
00:39:54,869 --> 00:40:00,869
charge of life support and climate

934
00:39:57,690 --> 00:40:02,880
control so they are in charge of

935
00:40:00,869 --> 00:40:04,559
basically the health and safety of the

936
00:40:02,880 --> 00:40:07,230
astronauts and making the International

937
00:40:04,559 --> 00:40:10,440
Space Station a livable place for us to

938
00:40:07,230 --> 00:40:13,440
send people they are in charge of

939
00:40:10,440 --> 00:40:17,490
ventilation not with a fan like this but

940
00:40:13,440 --> 00:40:19,590
with more fancy fans space fans if you

941

00:40:17,489 --> 00:40:22,219
will that are in the ducts for the space

942
00:40:19,590 --> 00:40:26,160
station because if you think about it in

943
00:40:22,219 --> 00:40:29,129
space there's no there's no gravity

944
00:40:26,159 --> 00:40:35,819
right here on earth if you have a pocket

945
00:40:29,130 --> 00:40:37,320
of hot air it rises high right so if you

946
00:40:35,820 --> 00:40:40,080
have a pocket of hot air rises and the

947
00:40:37,320 --> 00:40:43,230
cool air sinks but in space there isn't

948
00:40:40,079 --> 00:40:45,630
gravity to make those gradients happen

949
00:40:43,230 --> 00:40:48,329
so you can end up with kind of just a

950
00:40:45,630 --> 00:40:51,559
pocket of stagnant air just kind of

951
00:40:48,329 --> 00:40:53,940
there and it could smell bad or have a

952
00:40:51,559 --> 00:40:55,409
concentration of co2 in it or something

953
00:40:53,940 --> 00:40:56,760
like that so ventilation on the space

954
00:40:55,409 --> 00:40:58,170
station is really important you want to

955
00:40:56,760 --> 00:41:00,860

keep the air moving around so you don't

956

00:40:58,170 --> 00:41:03,980

end up with that stagnant pocket of air

957

00:41:00,860 --> 00:41:08,670

there also in charge of humidity control

958

00:41:03,980 --> 00:41:10,590

because again there is no gravity so

959

00:41:08,670 --> 00:41:12,360

things don't condense out of the air and

960

00:41:10,590 --> 00:41:13,980

fall to the ground it condenses out of

961

00:41:12,360 --> 00:41:15,960

the air and just kind of sticks to stuff

962

00:41:13,980 --> 00:41:17,300

you don't want that to happen so you

963

00:41:15,960 --> 00:41:19,670

want to keep really good control

964

00:41:17,300 --> 00:41:22,910

the humidity in the spacecraft also the

965

00:41:19,670 --> 00:41:25,460

temperature space is cold so they don't

966

00:41:22,909 --> 00:41:27,279

want the astronauts to be cold basically

967

00:41:25,460 --> 00:41:30,260

so they keep control of the temperature

968

00:41:27,280 --> 00:41:31,850

onboard the spacecraft to the ethos

969

00:41:30,260 --> 00:41:33,950

specialist is also in charge of

970
00:41:31,849 --> 00:41:35,889
emergencies on the spacecraft can anyone

971
00:41:33,949 --> 00:41:42,379
think of an emergency on a spacecraft

972
00:41:35,889 --> 00:41:45,230
hint yeah so on board the ISS there are

973
00:41:42,380 --> 00:41:47,119
three types of what you call an onboard

974
00:41:45,230 --> 00:41:48,889
emergency there are a lots and lots of

975
00:41:47,119 --> 00:41:50,630
things that could go wrong but there are

976
00:41:48,889 --> 00:41:52,549
three things that will cause everybody

977
00:41:50,630 --> 00:41:55,490
to stop what they're doing and take care

978
00:41:52,550 --> 00:41:57,920
of the emergency one of them is fire can

979
00:41:55,489 --> 00:42:01,519
anyone think of another one thanks yeah

980
00:41:57,920 --> 00:42:03,860
a leak or a rapid depressurization so if

981
00:42:01,519 --> 00:42:05,840
a micrometeoroid hits something and it

982
00:42:03,860 --> 00:42:08,630
starts to depressurize that's really bad

983
00:42:05,840 --> 00:42:10,519
we have to take all of the air up there

984
00:42:08,630 --> 00:42:13,610
and we don't want to let it just go out

985
00:42:10,519 --> 00:42:16,009
into space so a rapid depressurization

986
00:42:13,610 --> 00:42:17,809
or a leak is another one the third one

987
00:42:16,010 --> 00:42:24,980
is kind of strange the third one is an

988
00:42:17,809 --> 00:42:27,889
ammonia leak yeah there is one very very

989
00:42:24,980 --> 00:42:29,809
not likely path through which ammonia

990
00:42:27,889 --> 00:42:32,210
could be introduced into the atmosphere

991
00:42:29,809 --> 00:42:34,460
of the space station it's never happened

992
00:42:32,210 --> 00:42:36,530
it probably will never happen but

993
00:42:34,460 --> 00:42:38,720
someone realized one day that through a

994
00:42:36,530 --> 00:42:39,530
series of very unfortunate events it

995
00:42:38,719 --> 00:42:42,529
could happen

996
00:42:39,530 --> 00:42:44,480
so there are a lot of detection zhh in

997
00:42:42,530 --> 00:42:46,250
place and a lot of different signs that

998

00:42:44,480 --> 00:42:48,320
the ethos looks forward to make sure

999
00:42:46,250 --> 00:42:50,840
that ammonia doesn't get introduced into

1000
00:42:48,320 --> 00:42:59,090
the atmosphere because ammonia is really

1001
00:42:50,840 --> 00:43:00,620
bad if you weren't sure yeah the

1002
00:42:59,090 --> 00:43:02,030
question was how is it that the oxygen

1003
00:43:00,619 --> 00:43:03,769
doesn't run out in the space station

1004
00:43:02,030 --> 00:43:06,019
that is also something that the ethos

1005
00:43:03,769 --> 00:43:08,119
specialist is in charge of so on board

1006
00:43:06,019 --> 00:43:10,730
we have regenerative life support

1007
00:43:08,119 --> 00:43:14,389
systems so we can take the water and

1008
00:43:10,730 --> 00:43:17,269
turn it into oxygen and hydrogen and we

1009
00:43:14,389 --> 00:43:19,940
can even take like pea and turn it into

1010
00:43:17,269 --> 00:43:22,288
drinkable water so if you're not into

1011
00:43:19,940 --> 00:43:25,528
that don't be an astronaut but

1012
00:43:22,289 --> 00:43:30,239

I I hear that it tastes just like water

1013

00:43:25,528 --> 00:43:31,949

and you would never know we also when

1014

00:43:30,239 --> 00:43:34,889

the shuttle was flying we also used to

1015

00:43:31,949 --> 00:43:36,719

take big tanks of oxygen up to the space

1016

00:43:34,889 --> 00:43:38,909

station to refill it that way but the

1017

00:43:36,719 --> 00:43:40,469

shuttle is not flying anymore so I'm not

1018

00:43:38,909 --> 00:43:41,639

sure if any of the other spacecraft do

1019

00:43:40,469 --> 00:43:49,499

that but that's a good question I'll

1020

00:43:41,639 --> 00:43:51,239

have to look into that yeah no they

1021

00:43:49,498 --> 00:43:54,108

don't cover when astronauts get sick but

1022

00:43:51,239 --> 00:44:00,509

I will tell you in a few slides who does

1023

00:43:54,108 --> 00:44:01,949

yes so the question was what sort of

1024

00:44:00,509 --> 00:44:03,599

fire protection systems that they have

1025

00:44:01,949 --> 00:44:05,489

on board they have a lot of different

1026

00:44:03,599 --> 00:44:07,650

fire protection protection systems on

1027
00:44:05,489 --> 00:44:09,119
board because fire is probably the

1028
00:44:07,650 --> 00:44:11,509
number one thing they are very most

1029
00:44:09,119 --> 00:44:11,509
worried about

1030
00:44:12,228 --> 00:44:18,389
there are everything from you don't

1031
00:44:16,289 --> 00:44:20,400
really want to loose a fire extinguisher

1032
00:44:18,389 --> 00:44:22,318
and the space station because all those

1033
00:44:20,400 --> 00:44:24,630
particles will just kind of float away

1034
00:44:22,318 --> 00:44:26,219
they won't necessarily stay right at the

1035
00:44:24,630 --> 00:44:28,528
fire so it's everything from like you

1036
00:44:26,219 --> 00:44:31,079
can smother it with blankets they have

1037
00:44:28,528 --> 00:44:34,498
special fire blankets too even closing

1038
00:44:31,079 --> 00:44:36,119
off the hatch and venting out a module

1039
00:44:34,498 --> 00:44:38,488
to get rid of all the oxygen so the fire

1040
00:44:36,119 --> 00:44:39,659
dies so there there's a lot of different

1041
00:44:38,489 --> 00:44:41,759
ways depending on the severity of the

1042
00:44:39,659 --> 00:44:45,048
fire and the location of the fire what

1043
00:44:41,759 --> 00:44:47,389
the approach would be and all of the

1044
00:44:45,048 --> 00:44:50,788
procedures for this are in a big

1045
00:44:47,389 --> 00:44:52,858
notebook about this big also probably on

1046
00:44:50,789 --> 00:44:54,929
the computer but there are hard copies

1047
00:44:52,858 --> 00:44:56,219
backed up right behind all of the flight

1048
00:44:54,929 --> 00:44:58,108
controllers they can grab the emergency

1049
00:44:56,219 --> 00:45:00,778
notebook and say ok this is what we do

1050
00:44:58,108 --> 00:45:02,458
next so it's very likely that most of

1051
00:45:00,778 --> 00:45:04,588
the scenarios have been thought through

1052
00:45:02,458 --> 00:45:06,899
and they're able to combat the fire the

1053
00:45:04,588 --> 00:45:11,068
way that they need to in order to keep

1054
00:45:06,900 --> 00:45:14,489
the crew and the vehicle healthy yes

1055

00:45:11,068 --> 00:45:17,489
does Chronos have control over all ISS

1056
00:45:14,489 --> 00:45:19,349
uplink and downlink so say say Capcom

1057
00:45:17,489 --> 00:45:21,059
was it something the astronauts that

1058
00:45:19,349 --> 00:45:23,400
they get from ethos does it have to go

1059
00:45:21,059 --> 00:45:25,739
through cretinous first that's a good

1060
00:45:23,400 --> 00:45:26,389
question so the question was all of the

1061
00:45:25,739 --> 00:45:28,369
up Lincoln

1062
00:45:26,389 --> 00:45:30,318
like go through Cronus crota said the

1063
00:45:28,369 --> 00:45:33,170
person that owns the systems that allow

1064
00:45:30,318 --> 00:45:36,409
the uplink and downlink to happen but

1065
00:45:33,170 --> 00:45:38,750
they don't have to talk to Kronos first

1066
00:45:36,409 --> 00:45:40,190
before they talk to the astronauts it's

1067
00:45:38,750 --> 00:45:41,750
not the only way you can talk to the

1068
00:45:40,190 --> 00:45:43,849
astronauts so there's also a ham radio

1069
00:45:41,750 --> 00:45:46,369

on the space station that the astronauts

1070

00:45:43,849 --> 00:45:48,230

use sometimes so when it's flying over

1071

00:45:46,369 --> 00:45:51,440

if any of the astronauts are on the ham

1072

00:45:48,230 --> 00:45:55,010

radio you can talk to them that way okay

1073

00:45:51,440 --> 00:45:56,599

but Kronos is just in charge of the

1074

00:45:55,010 --> 00:45:58,789

systems that allow it to happen

1075

00:45:56,599 --> 00:46:01,220

that's the cronuts doesn't directly

1076

00:45:58,789 --> 00:46:04,220

authorize communication correct cronuts

1077

00:46:01,219 --> 00:46:06,528

just enables communication to happen so

1078

00:46:04,219 --> 00:46:09,879

the next console position that staff

1079

00:46:06,528 --> 00:46:12,318

24/7 is called Spartan station power

1080

00:46:09,880 --> 00:46:15,380

articulation thermal and analysis it's

1081

00:46:12,318 --> 00:46:17,838

another stretch kind of acronym name but

1082

00:46:15,380 --> 00:46:20,298

I think it's pretty cool my parents went

1083

00:46:17,838 --> 00:46:22,699

to Michigan State so I like the console

1084
00:46:20,298 --> 00:46:24,889
named Spartan so Spartan is in charge of

1085
00:46:22,699 --> 00:46:29,538
the electrical power onboard the space

1086
00:46:24,889 --> 00:46:32,000
station and the external thermal excuse

1087
00:46:29,539 --> 00:46:33,470
me on the space station you guys

1088
00:46:32,000 --> 00:46:36,619
probably know that the space station is

1089
00:46:33,469 --> 00:46:38,929
powered from solar energy so as Spartan

1090
00:46:36,619 --> 00:46:40,068
is the one Spartan is the console that's

1091
00:46:38,929 --> 00:46:42,230
in charge of making sure the solar

1092
00:46:40,068 --> 00:46:44,329
arrays are pointed at the Sun so that

1093
00:46:42,230 --> 00:46:46,278
we're getting the most power we can out

1094
00:46:44,329 --> 00:46:48,048
of the solar arrays they are also in

1095
00:46:46,278 --> 00:46:50,480
charge of routing that power from the

1096
00:46:48,048 --> 00:47:04,548
solar arrays to the various components

1097
00:46:50,480 --> 00:47:07,278
that need it yeah that's an excellent

1098
00:47:04,548 --> 00:47:09,318
question so she asked how ADCO is in

1099
00:47:07,278 --> 00:47:11,389
charge of how the space station is

1100
00:47:09,318 --> 00:47:13,849
oriented but oriented in terms of what

1101
00:47:11,389 --> 00:47:16,009
there's actually different attitudes at

1102
00:47:13,849 --> 00:47:17,599
which the space station can fly but for

1103
00:47:16,009 --> 00:47:20,088
the most part the space station flies

1104
00:47:17,599 --> 00:47:25,880
like an airplane would around the world

1105
00:47:20,088 --> 00:47:28,759
so it has a forward it has a thank you

1106
00:47:25,880 --> 00:47:30,920
it has an aft it has a port it has a

1107
00:47:28,759 --> 00:47:33,769
starboard but it also has what's called

1108
00:47:30,920 --> 00:47:35,838
a zenith which is up so away from the

1109
00:47:33,768 --> 00:47:38,629
earth and a nadir which is down towards

1110
00:47:35,838 --> 00:47:40,088
the earth and it flies around at about a

1111
00:47:38,630 --> 00:47:43,809
4 degrees of

1112

00:47:40,088 --> 00:47:45,909
every minute I think so it just kind of

1113
00:47:43,809 --> 00:47:49,839
constantly pitches nose over so that it

1114
00:47:45,909 --> 00:47:51,969
can fly around the earth there's other

1115
00:47:49,838 --> 00:47:56,588
orientations once upon a time there was

1116
00:47:51,969 --> 00:47:58,088
a solar array that broke and we had we

1117
00:47:56,588 --> 00:48:00,699
weren't getting as much power as we

1118
00:47:58,088 --> 00:48:02,889
needed to so instead of flying like this

1119
00:48:00,699 --> 00:48:06,670
we kind of took the solar arrays and

1120
00:48:02,889 --> 00:48:07,838
flew like this so instead of around the

1121
00:48:06,670 --> 00:48:12,278
earth like this we kind of just like

1122
00:48:07,838 --> 00:48:13,719
went around the earth like like this so

1123
00:48:12,278 --> 00:48:16,389
there's different attitudes you can fly

1124
00:48:13,719 --> 00:48:19,329
at and it's always though determined

1125
00:48:16,389 --> 00:48:21,538
pretty much earth relative how you're

1126
00:48:19,329 --> 00:48:24,699

flying does that answer your question

1127

00:48:21,539 --> 00:48:26,739

cool all right I'm gonna move on because

1128

00:48:24,699 --> 00:48:28,028

there's lots of positions save your

1129

00:48:26,739 --> 00:48:29,469

question for the end there's lots of

1130

00:48:28,028 --> 00:48:30,608

positions I want to make sure I get to

1131

00:48:29,469 --> 00:48:35,079

all of them and then talk a little bit

1132

00:48:30,608 --> 00:48:37,719

about the articulation in Spartan is the

1133

00:48:35,079 --> 00:48:39,249

articulation of the solar arrays yeah

1134

00:48:37,719 --> 00:48:41,588

how the solar arrays are pointed so they

1135

00:48:39,248 --> 00:48:44,018

can articulate like this like this and

1136

00:48:41,588 --> 00:48:46,900

also like this there's lots of exercises

1137

00:48:44,018 --> 00:48:50,528

you could do as a Space Station flight

1138

00:48:46,900 --> 00:48:52,269

controller to talk about your job okay

1139

00:48:50,528 --> 00:48:54,900

so those are the stage those are the

1140

00:48:52,268 --> 00:48:57,998

positions that are staffed 24/7 365

1141
00:48:54,900 --> 00:48:59,650
there are four consoles that are staffed

1142
00:48:57,998 --> 00:49:03,248
for what's called dynamic operations

1143
00:48:59,650 --> 00:49:04,959
those are operations that aren't usual

1144
00:49:03,248 --> 00:49:07,028
on the space station so it's something

1145
00:49:04,958 --> 00:49:09,068
like the docking of a spacecraft or a

1146
00:49:07,028 --> 00:49:12,099
spacewalk or the undocking of a

1147
00:49:09,068 --> 00:49:16,208
spacecraft or a robotics operation

1148
00:49:12,099 --> 00:49:20,048
something like that so we have a VA Robo

1149
00:49:16,208 --> 00:49:21,698
vvo and ice I'm going to talk about each

1150
00:49:20,048 --> 00:49:23,889
one of those now first we'll start with

1151
00:49:21,699 --> 00:49:25,989
EPA EPA stands for extra vehicular

1152
00:49:23,889 --> 00:49:28,239
activity they are the people who are in

1153
00:49:25,989 --> 00:49:30,369
charge of the spacewalks so anytime an

1154
00:49:28,239 --> 00:49:33,548
astronaut or a cosmonaut goes outside of

1155
00:49:30,369 --> 00:49:36,099
the space station the EPA people are in

1156
00:49:33,548 --> 00:49:37,389
charge of what happens they are also in

1157
00:49:36,099 --> 00:49:39,219
charge of training the astronauts you

1158
00:49:37,389 --> 00:49:40,808
guys may have seen pictures of it's

1159
00:49:39,219 --> 00:49:42,458
called the neutral buoyancy lab down in

1160
00:49:40,809 --> 00:49:44,079
Houston it's this giant swimming pool

1161
00:49:42,458 --> 00:49:44,798
that has the mock-up of a space station

1162
00:49:44,079 --> 00:49:46,150
in it

1163
00:49:44,798 --> 00:49:50,318
it's where the astronauts can go

1164
00:49:46,150 --> 00:49:52,150
practice being essentially weightless to

1165
00:49:50,318 --> 00:49:53,538
practice all the spacewalks they're

1166
00:49:52,150 --> 00:49:58,219
going to do in space

1167
00:49:53,539 --> 00:50:00,799
in on earth before they go into space so

1168
00:49:58,219 --> 00:50:03,769
that's the EBA console there on dock

1169

00:50:00,798 --> 00:50:06,798
when EPA's happen we also have the

1170
00:50:03,768 --> 00:50:08,898
robotics officer or Robo they are in

1171
00:50:06,798 --> 00:50:10,099
charge of the different robotics

1172
00:50:08,898 --> 00:50:12,259
operations on board the space station

1173
00:50:10,099 --> 00:50:15,079
most notably the space station robotic

1174
00:50:12,259 --> 00:50:17,630
arm and I'll talk a little bit more

1175
00:50:15,079 --> 00:50:19,609
about the robotic arm in a second we

1176
00:50:17,630 --> 00:50:24,829
also have the visiting vehicle officer

1177
00:50:19,608 --> 00:50:28,308
who is in charge of the following

1178
00:50:24,829 --> 00:50:31,459
spacecraft the Soyuz which is the

1179
00:50:28,309 --> 00:50:34,039
Russian spacecraft that brings people up

1180
00:50:31,458 --> 00:50:37,038
to the space station the ATV which is

1181
00:50:34,039 --> 00:50:39,229
the European Space Agency's cargo

1182
00:50:37,039 --> 00:50:40,880
resupply vehicle and the progress which

1183
00:50:39,228 --> 00:50:43,968

is the Russians the Russian space

1184
00:50:40,880 --> 00:50:46,880
agency's cargo resupply vehicle fun fact

1185
00:50:43,969 --> 00:50:50,148
the Soyuz and the progress are almost

1186
00:50:46,880 --> 00:50:52,369
identical except this one says Soyuz and

1187
00:50:50,148 --> 00:50:54,888
this one says progress if you can read

1188
00:50:52,369 --> 00:50:58,548
Russian if you can't read Russian the

1189
00:50:54,889 --> 00:51:00,229
Soyuz has a periscope on it for the

1190
00:50:58,548 --> 00:51:00,768
astronauts and cosmonauts to be able to

1191
00:51:00,228 --> 00:51:03,259
see out of

1192
00:51:00,768 --> 00:51:05,388
because cargo doesn't need to see but

1193
00:51:03,259 --> 00:51:09,559
the astronauts do so this one has a

1194
00:51:05,389 --> 00:51:11,298
periscope this one also has a crew cabin

1195
00:51:09,559 --> 00:51:13,369
right here that's pressurized

1196
00:51:11,298 --> 00:51:16,009
this isn't pressurized because again

1197
00:51:13,369 --> 00:51:18,528
cargo we don't care I mean we care we

1198
00:51:16,009 --> 00:51:21,199
need it don't get me wrong but not as

1199
00:51:18,528 --> 00:51:24,018
much as we care about crew so then we

1200
00:51:21,199 --> 00:51:26,148
have the integration systems engineer or

1201
00:51:24,018 --> 00:51:27,918
ice they are in charge of the vehicles

1202
00:51:26,148 --> 00:51:32,958
that come to this fate to the space

1203
00:51:27,918 --> 00:51:35,828
station that are the Japanese HTV the

1204
00:51:32,958 --> 00:51:40,068
Cygnus the orbital Cygnus vehicle and

1205
00:51:35,829 --> 00:51:42,949
SpaceX's dragon vehicle can anyone spot

1206
00:51:40,068 --> 00:51:44,478
a difference between the vehicles videos

1207
00:51:42,949 --> 00:51:47,438
in charge of and the vehicles that ice

1208
00:51:44,478 --> 00:51:52,009
is in charge of just from these pictures

1209
00:51:47,438 --> 00:51:55,148
what yes so that is one difference these

1210
00:51:52,009 --> 00:51:57,139
are commercial vehicles here what about

1211
00:51:55,148 --> 00:52:01,038
there's something in these pictures

1212
00:51:57,139 --> 00:52:02,630
that's not in these pictures yeah so the

1213
00:52:01,039 --> 00:52:05,528
spacecraft don't have the arms that's

1214
00:52:02,630 --> 00:52:06,890
actually the space stations robotic arm

1215
00:52:05,528 --> 00:52:09,099
these V

1216
00:52:06,889 --> 00:52:11,659
people's here the Soyuz progress an ATV

1217
00:52:09,099 --> 00:52:14,450
dynamically duct to the space station so

1218
00:52:11,659 --> 00:52:16,879
they actually fly in and autonomously or

1219
00:52:14,449 --> 00:52:20,210
are piloted duck to the space station

1220
00:52:16,880 --> 00:52:22,099
these vehicles here we reach out and

1221
00:52:20,210 --> 00:52:24,588
grab them with the robotic arm and then

1222
00:52:22,099 --> 00:52:26,838
carefully bring them in to berth to the

1223
00:52:24,588 --> 00:52:30,250
space station that's the difference

1224
00:52:26,838 --> 00:52:35,028
between docking and berthing who knew

1225
00:52:30,250 --> 00:52:37,219
what I learned so ice is in charge of

1226

00:52:35,028 --> 00:52:38,568
those vehicles that berths and videos in

1227
00:52:37,219 --> 00:52:40,129
charge of the vehicles that dynamically

1228
00:52:38,568 --> 00:52:44,719
dock to the space station

1229
00:52:40,130 --> 00:52:46,220
yes it is the same arm that the robotics

1230
00:52:44,719 --> 00:52:47,268
officers in charge of oh that's why I

1231
00:52:46,219 --> 00:52:50,348
said I was going to talk about it again

1232
00:52:47,268 --> 00:52:53,298
that's good so the robotics officer

1233
00:52:50,349 --> 00:52:56,150
works with ice to capture these vehicles

1234
00:52:53,298 --> 00:52:57,920
so ice is the system's expert on the

1235
00:52:56,150 --> 00:52:59,990
vehicles and they work closely with Robo

1236
00:52:57,920 --> 00:53:05,510
to reach out capture the vehicles and

1237
00:52:59,989 --> 00:53:08,989
berth them to the space station actually

1238
00:53:05,510 --> 00:53:10,069
they don't these these ones all dock to

1239
00:53:08,989 --> 00:53:13,568
the Russian side of the space station

1240
00:53:10,068 --> 00:53:15,619

and these all docked to the European

1241
00:53:13,568 --> 00:53:17,480
Japanese and American side of the space

1242
00:53:15,619 --> 00:53:19,119
station the space station is kind of

1243
00:53:17,480 --> 00:53:22,099
like two space stations stuck together

1244
00:53:19,119 --> 00:53:24,289
that's not the official NASA like

1245
00:53:22,099 --> 00:53:24,859
terminology but it's my official

1246
00:53:24,289 --> 00:53:27,140
terminology

1247
00:53:24,858 --> 00:53:29,028
you've got the Russian side and the US

1248
00:53:27,139 --> 00:53:32,210
side and they're kind of just like step

1249
00:53:29,028 --> 00:53:34,730
together and then on the US side we also

1250
00:53:32,210 --> 00:53:37,088
have a European module and a Japanese

1251
00:53:34,730 --> 00:53:39,588
module and a handful of other things but

1252
00:53:37,088 --> 00:53:41,599
International Cooperation it's a really

1253
00:53:39,588 --> 00:53:44,509
good thing we just kind of stick them

1254
00:53:41,599 --> 00:53:47,410
together well I'll talk a little bit

1255
00:53:44,509 --> 00:53:50,809
more about that in a second so we have

1256
00:53:47,409 --> 00:53:54,558
these are the dynamic operations console

1257
00:53:50,809 --> 00:53:57,829
positions so we also have four consoles

1258
00:53:54,559 --> 00:53:59,509
that support daily stuff I didn't think

1259
00:53:57,829 --> 00:54:03,589
of a better term for it so I call it

1260
00:53:59,509 --> 00:54:06,400
daily stuff so we have ops plan ISO Oso

1261
00:54:03,588 --> 00:54:08,630
and Pluto

1262
00:54:06,400 --> 00:54:11,960
they're all up there yeah we'll get

1263
00:54:08,630 --> 00:54:14,840
there so us plan is the operations

1264
00:54:11,960 --> 00:54:18,619
planner the space station is a very very

1265
00:54:14,840 --> 00:54:20,570
very very very very very complex thing

1266
00:54:18,619 --> 00:54:22,039
there is all sorts of systems that have

1267
00:54:20,570 --> 00:54:24,140
to operate in conjunction with each

1268
00:54:22,039 --> 00:54:26,119
other there are people that have to be

1269
00:54:24,139 --> 00:54:28,609
scheduled throughout the day astronauts

1270
00:54:26,119 --> 00:54:31,219
have to do things like eat and sleep and

1271
00:54:28,610 --> 00:54:32,510
stuff ops plan is the console that's in

1272
00:54:31,219 --> 00:54:35,029
charge of making the schedule for

1273
00:54:32,510 --> 00:54:37,430
everything this is a screenshot of a

1274
00:54:35,030 --> 00:54:38,840
thing called OST PV because we can't

1275
00:54:37,429 --> 00:54:42,079
just call it the schedule when we could

1276
00:54:38,840 --> 00:54:44,240
call it OST PV it stands for the onboard

1277
00:54:42,079 --> 00:54:46,250
short-term plan viewer and it is

1278
00:54:44,239 --> 00:54:49,669
literally everything that's happening on

1279
00:54:46,250 --> 00:54:52,309
the ISS at any given time so time goes

1280
00:54:49,670 --> 00:54:55,220
this way and then these different bands

1281
00:54:52,309 --> 00:54:57,409
are I don't know I am pointing when I

1282
00:54:55,219 --> 00:55:01,849
have a laser these different bands are

1283

00:54:57,409 --> 00:55:04,759
the crew here so this is the commander

1284
00:55:01,849 --> 00:55:08,690
all of his activities or her activities

1285
00:55:04,760 --> 00:55:11,030
are here this is when the ISS is in

1286
00:55:08,690 --> 00:55:12,970
Eclipse or in insulation this is when we

1287
00:55:11,030 --> 00:55:15,800
have different communications contacts

1288
00:55:12,969 --> 00:55:18,769
literally everything on the ISS is on

1289
00:55:15,800 --> 00:55:21,170
OST PV ops plan is the person who takes

1290
00:55:18,769 --> 00:55:23,239
all of that information not the person

1291
00:55:21,170 --> 00:55:24,950
the console it's not just one guy but

1292
00:55:23,239 --> 00:55:27,109
they take all of that information and

1293
00:55:24,949 --> 00:55:30,139
they condense it into this plan that

1294
00:55:27,110 --> 00:55:34,610
everybody follows here's a picture of a

1295
00:55:30,139 --> 00:55:38,089
real live astronaut using it has anyone

1296
00:55:34,610 --> 00:55:40,309
seen the movie gravity so in the movie

1297
00:55:38,090 --> 00:55:42,170

gravity not to spoil anything but

1298

00:55:40,309 --> 00:55:44,299

there's a scene that takes place inside

1299

00:55:42,170 --> 00:55:50,329

the space station and if you look at the

1300

00:55:44,300 --> 00:55:52,070

computers it has OST PV on it I think

1301

00:55:50,329 --> 00:55:55,159

that's really cool I got really excited

1302

00:55:52,070 --> 00:55:58,550

it was like oh look at the screen no one

1303

00:55:55,159 --> 00:56:00,739

no one cared so ok I'm next we have AI

1304

00:55:58,550 --> 00:56:04,010

so does the inventory and stowage

1305

00:56:00,739 --> 00:56:06,589

officer I want you all to picture taking

1306

00:56:04,010 --> 00:56:10,940

a basket of laundry and throwing it onto

1307

00:56:06,590 --> 00:56:13,130

a bed falls nicely onto the bed right

1308

00:56:10,940 --> 00:56:14,929

now picture being in space and taking

1309

00:56:13,130 --> 00:56:18,380

that basket of laundry and throwing it

1310

00:56:14,929 --> 00:56:20,599

onto a bed and it all floats away

1311

00:56:18,380 --> 00:56:23,000

that's pretty much what the inventory

1312
00:56:20,599 --> 00:56:24,589
stowage officer has to deal with they're

1313
00:56:23,000 --> 00:56:25,730
in charge of stowing everything on the

1314
00:56:24,590 --> 00:56:28,039
space station and knowing where

1315
00:56:25,730 --> 00:56:29,599
everything is it might seem like a

1316
00:56:28,039 --> 00:56:32,269
menial task but I can assure you that

1317
00:56:29,599 --> 00:56:34,639
it's not even the littlest things like

1318
00:56:32,269 --> 00:56:36,259
pens just kind of float away

1319
00:56:34,639 --> 00:56:38,359
remember those events I was talking

1320
00:56:36,260 --> 00:56:40,370
about earlier they have they have

1321
00:56:38,360 --> 00:56:41,750
filters on them that capture things like

1322
00:56:40,369 --> 00:56:46,219
this so every now and then just go like

1323
00:56:41,750 --> 00:56:47,840
get a pen off event and use it so I so I

1324
00:56:46,219 --> 00:56:49,969
was in charge of whenever we have our

1325
00:56:47,840 --> 00:56:52,070
cargo resupply vehicle they have to have

1326
00:56:49,969 --> 00:56:53,929
identified everything that's in the

1327
00:56:52,070 --> 00:56:55,670
vehicle and where it's going to go and

1328
00:56:53,929 --> 00:56:57,440
then they have to identify everything

1329
00:56:55,670 --> 00:57:00,019
that's already up there that can get

1330
00:56:57,440 --> 00:57:02,450
returned back to the earth or trashed

1331
00:57:00,019 --> 00:57:06,019
and burned up in space that's a very

1332
00:57:02,449 --> 00:57:08,750
green process on the space station so

1333
00:57:06,019 --> 00:57:10,489
next we have oh so the Operations

1334
00:57:08,750 --> 00:57:14,619
Support Officer and the best way to

1335
00:57:10,489 --> 00:57:17,659
describe what Oso is like MacGyver or

1336
00:57:14,619 --> 00:57:22,940
if you were born after 2000

1337
00:57:17,659 --> 00:57:24,769
it's like MacGyver so basically they're

1338
00:57:22,940 --> 00:57:26,210
the ones who are in charge of helping

1339
00:57:24,769 --> 00:57:28,759
the astronauts fix things when it's

1340

00:57:26,210 --> 00:57:30,619
broken on the space station the thing

1341
00:57:28,760 --> 00:57:34,210
that they probably most commonly fix is

1342
00:57:30,619 --> 00:57:38,839
the toilet because you've got six people

1343
00:57:34,210 --> 00:57:41,809
using like two toilets and it's not like

1344
00:57:38,840 --> 00:57:43,340
a simple toilet because again the no

1345
00:57:41,809 --> 00:57:44,779
gravity thing makes it difficult so

1346
00:57:43,340 --> 00:57:48,860
there's lots of fans and moving parts

1347
00:57:44,780 --> 00:57:50,570
and bags and stuff so they actually

1348
00:57:48,860 --> 00:57:52,760
spend a lot of time fixing toilets

1349
00:57:50,570 --> 00:57:54,980
fixing a lot of the life-support

1350
00:57:52,760 --> 00:57:56,450
regeneration systems things like that

1351
00:57:54,980 --> 00:57:58,550
anything that breaks on board

1352
00:57:56,449 --> 00:58:00,319
oh so probably knows how to fix it you

1353
00:57:58,550 --> 00:58:02,539
also have to have really good hair to be

1354
00:58:00,320 --> 00:58:07,120

a know so

1355

00:58:02,539 --> 00:58:10,340

it's just like mandatory so next we have

1356

00:58:07,119 --> 00:58:12,440

whoops MacGyver again wrong way next we

1357

00:58:10,340 --> 00:58:14,870

have Pluto which is the plug-in port

1358

00:58:12,440 --> 00:58:16,250

utilization officer this is the console

1359

00:58:14,869 --> 00:58:18,980

that's literally in charge of making

1360

00:58:16,250 --> 00:58:22,190

sure things can get plugged in to have

1361

00:58:18,980 --> 00:58:25,219

power when they need it think about in

1362

00:58:22,190 --> 00:58:28,099

your house say you're running a hair

1363

00:58:25,219 --> 00:58:30,109

dryer and a heater and an air

1364

00:58:28,099 --> 00:58:32,329

conditioner for whatever reason and a

1365

00:58:30,110 --> 00:58:33,800

fuse blows in your house no big deal go

1366

00:58:32,329 --> 00:58:35,929

downstairs flip the fuse go back

1367

00:58:33,800 --> 00:58:38,180

upstairs resume your activities well

1368

00:58:35,929 --> 00:58:40,219

maybe not all of them but resume what

1369
00:58:38,179 --> 00:58:41,929
you're doing it's a really really bad

1370
00:58:40,219 --> 00:58:45,069
thing when a fuse blows on the space

1371
00:58:41,929 --> 00:58:48,109
station so the Pluto is in charge of

1372
00:58:45,070 --> 00:58:49,970
really just making sure if an astronaut

1373
00:58:48,110 --> 00:58:51,769
takes their computer over here and needs

1374
00:58:49,969 --> 00:58:54,439
to plug it in can they plug it into that

1375
00:58:51,769 --> 00:58:56,360
port will it cause a problem what else

1376
00:58:54,440 --> 00:58:59,360
is being powered off that line things

1377
00:58:56,360 --> 00:59:03,620
like that so it sounds kind of menial

1378
00:58:59,360 --> 00:59:06,200
but it's super important next we have

1379
00:59:03,619 --> 00:59:07,819
four consoles of other stuff the ones

1380
00:59:06,199 --> 00:59:15,669
before were the daily stuff this is the

1381
00:59:07,820 --> 00:59:18,350
other stuff we have BM e Rio topo and GC

1382
00:59:15,670 --> 00:59:20,059
first we'll talk about BM e BM e it was

1383
00:59:18,349 --> 00:59:22,819
the answer to your question previously

1384
00:59:20,059 --> 00:59:24,829
about the actual health of the

1385
00:59:22,820 --> 00:59:27,350
astronauts so they are the doctors who

1386
00:59:24,829 --> 00:59:30,529
are on call to help with the astronauts

1387
00:59:27,349 --> 00:59:32,269
so they don't staff all the time they're

1388
00:59:30,530 --> 00:59:33,920
there usually when a crew has a medical

1389
00:59:32,269 --> 00:59:36,590
conference or something like that crews

1390
00:59:33,920 --> 00:59:38,690
have medical conferences planned so that

1391
00:59:36,590 --> 00:59:42,380
we are always on top of the health of

1392
00:59:38,690 --> 00:59:43,909
the crew DME and their counterpart

1393
00:59:42,380 --> 00:59:45,410
surgeon are some of the only other

1394
00:59:43,909 --> 00:59:46,969
people who talk to the crew besides

1395
00:59:45,409 --> 00:59:48,949
Capcom because you wouldn't want

1396
00:59:46,969 --> 00:59:51,409
necessarily want like a medical

1397

00:59:48,949 --> 00:59:54,529
emergency being translated by some dude

1398
00:59:51,409 --> 00:59:56,389
on a console so they're the ones in

1399
00:59:54,530 --> 00:59:59,030
charge of making sure the crew is

1400
00:59:56,389 --> 01:00:00,889
healthy then we have Rio which is the

1401
00:59:59,030 --> 01:00:02,300
remote interface officer this is the

1402
01:00:00,889 --> 01:00:05,929
console I worked when I was at Mission

1403
01:00:02,300 --> 01:00:07,490
Control Rio is in charge of making sure

1404
01:00:05,929 --> 01:00:09,710
that all of the different systems and

1405
01:00:07,489 --> 01:00:11,899
international partners work together in

1406
01:00:09,710 --> 01:00:13,400
a nice fashion so the way I said before

1407
01:00:11,900 --> 01:00:15,480
there's kind of two space stations stuck

1408
01:00:13,400 --> 01:00:17,160
together everything here

1409
01:00:15,480 --> 01:00:18,869
this is an outdated picture so don't

1410
01:00:17,159 --> 01:00:22,618
look closely but everything here in

1411
01:00:18,869 --> 01:00:25,470

yellow belongs to the US everything in

1412

01:00:22,619 --> 01:00:29,608

red belongs to the Russians pink is

1413

01:00:25,469 --> 01:00:34,608

Japanese green is European this is the

1414

01:00:29,608 --> 01:00:39,029

Canadian arm right there in blue and

1415

01:00:34,608 --> 01:00:40,980

then some other stuff so as you can see

1416

01:00:39,030 --> 01:00:43,800

it is actually an International Space

1417

01:00:40,980 --> 01:00:45,960

Station you can also tell up here on the

1418

01:00:43,800 --> 01:00:50,160

Russian side up at the very top there

1419

01:00:45,960 --> 01:00:52,289

are some solar arrays up there we also

1420

01:00:50,159 --> 01:00:54,299

have solar arrays so that's a really

1421

01:00:52,289 --> 01:00:56,039

good example of how there are redundant

1422

01:00:54,300 --> 01:00:57,750

systems on the space station

1423

01:00:56,039 --> 01:01:00,119

the Russians have solar arrays that can

1424

01:00:57,750 --> 01:01:02,789

provide power we generally use our solar

1425

01:01:00,119 --> 01:01:05,309

arrays but every now and then we use

1426
01:01:02,789 --> 01:01:07,469
theirs sometimes most the time we give

1427
01:01:05,309 --> 01:01:10,829
power to the Russian side so that they

1428
01:01:07,469 --> 01:01:14,730
can do certain things the Russian side

1429
01:01:10,829 --> 01:01:16,289
of the spacecraft is in charge of they

1430
01:01:14,730 --> 01:01:18,599
have all the thrusters that actually

1431
01:01:16,289 --> 01:01:20,279
move the spacecraft dynamically out of

1432
01:01:18,599 --> 01:01:22,469
the way of say debris or something like

1433
01:01:20,280 --> 01:01:24,300
that so it really is an International

1434
01:01:22,469 --> 01:01:26,219
Space Station and the real console is in

1435
01:01:24,300 --> 01:01:28,109
charge of coordinating all of the

1436
01:01:26,219 --> 01:01:31,319
systems work between the international

1437
01:01:28,108 --> 01:01:33,420
partners we have a team of people who go

1438
01:01:31,320 --> 01:01:35,670
out to Mission Control Moscow and sit

1439
01:01:33,420 --> 01:01:37,170
out there for three months at a time but

1440
01:01:35,670 --> 01:01:38,639
don't just sit on console for three

1441
01:01:37,170 --> 01:01:40,530
months they go live in Moscow for three

1442
01:01:38,639 --> 01:01:42,000
months and then we have a contingent of

1443
01:01:40,530 --> 01:01:43,920
Russians who live in Houston for three

1444
01:01:42,000 --> 01:01:45,329
months so we always have kind of boots

1445
01:01:43,920 --> 01:01:47,099
on the ground presence in the other

1446
01:01:45,329 --> 01:01:48,630
Mission Control Center so that if

1447
01:01:47,099 --> 01:01:50,489
there's a problem we can just walk down

1448
01:01:48,630 --> 01:01:53,608
the hall and say hey Sergei what's going

1449
01:01:50,489 --> 01:01:55,289
on and they can say nothing and we'll go

1450
01:01:53,608 --> 01:01:59,219
blow them why does it look like there is

1451
01:01:55,289 --> 01:02:02,539
but yeah so that was a console I worked

1452
01:01:59,219 --> 01:02:04,589
when I was working in Mission Control

1453
01:02:02,539 --> 01:02:06,900
next we have topo which is the

1454

01:02:04,590 --> 01:02:08,820
trajectory Operations Officer they're in

1455
01:02:06,900 --> 01:02:12,480
charge of making sure that ISS doesn't

1456
01:02:08,820 --> 01:02:20,550
hit any of this stuff in space they work

1457
01:02:12,480 --> 01:02:22,500
directly with NORAD some of their cold I

1458
01:02:20,550 --> 01:02:23,880
don't remember but the the Air Force

1459
01:02:22,500 --> 01:02:26,789
people who know where all this stuff is

1460
01:02:23,880 --> 01:02:28,940
in space they they track all of the

1461
01:02:26,789 --> 01:02:30,380
space debris and topo

1462
01:02:28,940 --> 01:02:32,329
directly with them to make sure we don't

1463
01:02:30,380 --> 01:02:35,809
hit anything because again hitting

1464
01:02:32,329 --> 01:02:37,519
things in space is bad so every now and

1465
01:02:35,809 --> 01:02:39,920
then we have to do what's called a

1466
01:02:37,519 --> 01:02:41,960
debris avoidance maneuver or a dam which

1467
01:02:39,920 --> 01:02:43,880
i think is a very appropriate acronym

1468
01:02:41,960 --> 01:02:45,559

for what happens when you're about to

1469

01:02:43,880 --> 01:02:48,440

hit something you have to move out of

1470

01:02:45,559 --> 01:02:50,858

the way really quick so Tocco are the

1471

01:02:48,440 --> 01:02:53,450

people who coordinate that they

1472

01:02:50,858 --> 01:02:55,068

understand how much we have to move out

1473

01:02:53,449 --> 01:02:56,838

of the way and when we have to do it and

1474

01:02:55,068 --> 01:02:58,730

if it will put us in the path of other

1475

01:02:56,838 --> 01:03:00,679

things that could hit us it's very

1476

01:02:58,730 --> 01:03:04,940

crowded up there in space so topo has a

1477

01:03:00,679 --> 01:03:06,949

quite a job we also have GC which is

1478

01:03:04,940 --> 01:03:10,400

ground control ground control is in

1479

01:03:06,949 --> 01:03:13,429

charge of the actual facility of Mission

1480

01:03:10,400 --> 01:03:15,858

Control so even if it's too hot

1481

01:03:13,429 --> 01:03:18,049

ground control is the person who turns

1482

01:03:15,858 --> 01:03:20,179

the air conditioner on which never

1483
01:03:18,050 --> 01:03:26,269
happened it was always too cold ground

1484
01:03:20,179 --> 01:03:28,719
control as we learned from someone in

1485
01:03:26,269 --> 01:03:31,550
the song ground control to Major Tom

1486
01:03:28,719 --> 01:03:34,219
he erroneously says that ground control

1487
01:03:31,550 --> 01:03:37,579
talks to Major Tom but he doesn't we all

1488
01:03:34,219 --> 01:03:40,939
know that that is that talks the

1489
01:03:37,579 --> 01:03:44,780
astronauts very good so rock and roll is

1490
01:03:40,940 --> 01:03:48,440
not always accurate so that's what you

1491
01:03:44,780 --> 01:03:50,690
should take away from this so just to

1492
01:03:48,440 --> 01:03:52,400
recap a little bit we have flight

1493
01:03:50,690 --> 01:03:53,869
director and Capcom here in the middle

1494
01:03:52,400 --> 01:03:54,440
in charge of everything talking to the

1495
01:03:53,869 --> 01:03:57,588
astronauts

1496
01:03:54,440 --> 01:04:00,920
we have Kronos ADCO ethos and Spartan

1497
01:03:57,588 --> 01:04:04,159
who are staffed 24/7 365

1498
01:04:00,920 --> 01:04:07,030
we've got Robo ice VBO and EBA who are

1499
01:04:04,159 --> 01:04:09,949
in charge of the the dynamic operations

1500
01:04:07,030 --> 01:04:13,250
we've got I had a lot of fun with the

1501
01:04:09,949 --> 01:04:15,588
power point things so we have ISO Oso

1502
01:04:13,250 --> 01:04:17,960
ops plane and Pluto who are in charge of

1503
01:04:15,588 --> 01:04:19,489
the daily stuff and then we have like a

1504
01:04:17,960 --> 01:04:22,760
lot of fun with PowerPoint and then we

1505
01:04:19,489 --> 01:04:25,039
have BM a topo DC and Rio who are in

1506
01:04:22,760 --> 01:04:29,250
charge of just kind of the other random

1507
01:04:25,039 --> 01:04:33,090
stuff so yeah

1508
01:04:29,250 --> 01:04:34,769
I did it wasn't a requirement but it was

1509
01:04:33,090 --> 01:04:36,120
very useful to know Russian so when I

1510
01:04:34,769 --> 01:04:38,519
was in high school I studied abroad in

1511

01:04:36,119 --> 01:04:40,679
Russia for a year so I learned Russian

1512
01:04:38,519 --> 01:04:43,139
pretty well and then it was very useful

1513
01:04:40,679 --> 01:04:46,079
to know Russian when people don't think

1514
01:04:43,139 --> 01:04:48,599
that I know Russian when I was in Russia

1515
01:04:46,079 --> 01:04:50,159
so I learned a lot of fun things our

1516
01:04:48,599 --> 01:04:53,130
console worked with interpreters and

1517
01:04:50,159 --> 01:04:54,239
translators to do the actual work but

1518
01:04:53,130 --> 01:04:56,280
every now and then you know you could

1519
01:04:54,239 --> 01:04:57,629
overhear things you also got a lot more

1520
01:04:56,280 --> 01:04:58,680
respect when you could walk into their

1521
01:04:57,630 --> 01:05:00,780
office and talk to them without a

1522
01:04:58,679 --> 01:05:04,500
translator and say hey what's going on

1523
01:05:00,780 --> 01:05:07,500
let's figure this out so I to speak

1524
01:05:04,500 --> 01:05:09,780
Russian a lot better than I do my dog

1525
01:05:07,500 --> 01:05:10,980

speaks Russian a little bit so she's

1526

01:05:09,780 --> 01:05:13,560
really the only one I get to talk

1527

01:05:10,980 --> 01:05:18,750
Russian to anymore you have told us that

1528

01:05:13,559 --> 01:05:20,730
the point director makes all but you

1529

01:05:18,750 --> 01:05:22,110
told us that the Japanese have a flight

1530

01:05:20,730 --> 01:05:24,929
director the Russians in the flight

1531

01:05:22,110 --> 01:05:27,059
director in several others so how do you

1532

01:05:24,929 --> 01:05:29,909
coordinate all of those flight directors

1533

01:05:27,059 --> 01:05:31,679
each one which is the Czar well each one

1534

01:05:29,909 --> 01:05:33,059
isn't really a czar so the question was

1535

01:05:31,679 --> 01:05:34,980
how do you coordinate the different

1536

01:05:33,059 --> 01:05:36,119
flight directors the different

1537

01:05:34,980 --> 01:05:38,490
international flight directors so you

1538

01:05:36,119 --> 01:05:40,409
have the flight director in Houston the

1539

01:05:38,489 --> 01:05:44,309
flight director in Moscow the one in

1540
01:05:40,409 --> 01:05:47,819
Japan in Germany and then one in Canada

1541
01:05:44,309 --> 01:05:49,500
I believe so it's not a thing that has

1542
01:05:47,820 --> 01:05:52,860
to be coordinated in real time really

1543
01:05:49,500 --> 01:05:55,579
it's more an understanding that the

1544
01:05:52,860 --> 01:05:58,769
flight director in Houston has final say

1545
01:05:55,579 --> 01:06:01,980
period however if we're doing something

1546
01:05:58,769 --> 01:06:02,909
that is say a vehicle is docking to the

1547
01:06:01,980 --> 01:06:05,250
Russian side of the space station

1548
01:06:02,909 --> 01:06:08,670
something that's really more Russian

1549
01:06:05,250 --> 01:06:10,500
centric operation the flight director in

1550
01:06:08,670 --> 01:06:12,030
Houston will most likely defer to the

1551
01:06:10,500 --> 01:06:14,670
flight director in Russia for that but

1552
01:06:12,030 --> 01:06:16,500
if at that time an emergency were to

1553
01:06:14,670 --> 01:06:18,570
occur the flight director in Houston

1554
01:06:16,500 --> 01:06:20,699
would assume responsibility and worked

1555
01:06:18,570 --> 01:06:23,010
the emergency does that kind of make

1556
01:06:20,699 --> 01:06:25,250
sense so it's it's a it's kind of a

1557
01:06:23,010 --> 01:06:28,110
political game but it's one that is

1558
01:06:25,250 --> 01:06:30,360
thought out long before it actually has

1559
01:06:28,110 --> 01:06:32,010
to be into practice and it's just an

1560
01:06:30,360 --> 01:06:34,980
agreement amongst everyone there's no

1561
01:06:32,010 --> 01:06:36,810
law or international policy that governs

1562
01:06:34,980 --> 01:06:38,610
this it's more just oh we want the space

1563
01:06:36,809 --> 01:06:42,829
station to work and to continue working

1564
01:06:38,610 --> 01:06:42,829
so we'll do whatever it takes

1565
01:06:42,909 --> 01:07:07,578
any collusion it's kind of a mixture of

1566
01:07:05,329 --> 01:07:10,089
English and Russian I'm yeah English and

1567
01:07:07,579 --> 01:07:12,798
Russian most of the all of the Russian

1568

01:07:10,088 --> 01:07:14,480
cosmonauts speak English most of the

1569
01:07:12,798 --> 01:07:16,369
Russian most of the American and

1570
01:07:14,480 --> 01:07:19,219
European and everybody else

1571
01:07:16,369 --> 01:07:21,650
astronauts speak Russian or at least

1572
01:07:19,219 --> 01:07:24,230
have some Russian training the the

1573
01:07:21,650 --> 01:07:26,150
number one language that is spoken is

1574
01:07:24,230 --> 01:07:27,769
English so if an emergency were to occur

1575
01:07:26,150 --> 01:07:31,970
the dialogue would happened in English

1576
01:07:27,768 --> 01:07:34,118
but there are Russians when they talk to

1577
01:07:31,969 --> 01:07:36,498
Moscow Mission Control speak in Russian

1578
01:07:34,119 --> 01:07:39,318
but while that's happening there are

1579
01:07:36,498 --> 01:07:40,909
translators on the voice loops that

1580
01:07:39,318 --> 01:07:43,130
translate for the American flight

1581
01:07:40,909 --> 01:07:45,528
control team there are Russian

1582
01:07:43,130 --> 01:07:47,900

translators in Moscow who translate all

1583

01:07:45,528 --> 01:07:50,809

the English for the Russians so it's

1584

01:07:47,900 --> 01:07:52,400

primarily English in Russian and then

1585

01:07:50,809 --> 01:07:53,930

just depending on what other crew is up

1586

01:07:52,400 --> 01:08:10,759

there other things could happen in other

1587

01:07:53,929 --> 01:08:12,018

languages on the ground was about fixing

1588

01:08:10,759 --> 01:08:14,179

toilets is there's someone on the ground

1589

01:08:12,018 --> 01:08:15,649

who can fix it remotely or are they

1590

01:08:14,179 --> 01:08:17,479

working with the astronauts or will it

1591

01:08:15,650 --> 01:08:18,529

come back and get it fixed and the

1592

01:08:17,479 --> 01:08:20,329

answer is they're working with the

1593

01:08:18,529 --> 01:08:21,859

astronauts so part of the glourious

1594

01:08:20,329 --> 01:08:24,198

training of becoming an astronaut is

1595

01:08:21,859 --> 01:08:26,150

learning how to fix a space toilet and

1596

01:08:24,198 --> 01:08:29,858

learning how to use a space toilet which

1597
01:08:26,149 --> 01:08:29,858
is actually an interesting training

1598
01:08:29,998 --> 01:08:34,408
some about it but so the how not to know

1599
01:08:33,029 --> 01:08:37,049
how to do it before they get up there

1600
01:08:34,408 --> 01:08:39,298
but the ants have learned a lot of

1601
01:08:37,048 --> 01:08:41,368
things before they go into space so they

1602
01:08:39,298 --> 01:08:43,349
work in conjunction with Oso to make

1603
01:08:41,368 --> 01:08:45,658
sure that they're putting the right

1604
01:08:43,349 --> 01:08:48,659
things in the right places and fixing

1605
01:08:45,658 --> 01:08:50,098
them the way it needs to be fixed I'm

1606
01:08:48,658 --> 01:09:02,568
gonna keep going because next I want to

1607
01:08:50,099 --> 01:09:06,210
talk about yes four things and supplies

1608
01:09:02,569 --> 01:09:08,009
so the question was about the invisible

1609
01:09:06,210 --> 01:09:11,069
planning for things like meals and

1610
01:09:08,009 --> 01:09:12,420
supplies what you need to send up at

1611
01:09:11,069 --> 01:09:15,029
what times where does that take place

1612
01:09:12,420 --> 01:09:17,130
that all takes place in a lot of the

1613
01:09:15,029 --> 01:09:19,409
rest of Johnson Space Center so there's

1614
01:09:17,130 --> 01:09:21,900
a place that develops a lot of the food

1615
01:09:19,408 --> 01:09:23,670
that the astronauts eat there is a whole

1616
01:09:21,899 --> 01:09:25,888
division that's devoted just to

1617
01:09:23,670 --> 01:09:28,229
understanding what resources are on the

1618
01:09:25,889 --> 01:09:30,389
space station when those resources are

1619
01:09:28,229 --> 01:09:32,130
going to deplete when we need to refill

1620
01:09:30,389 --> 01:09:34,588
them that's not something that happens

1621
01:09:32,130 --> 01:09:36,359
in real time in Mission Control it just

1622
01:09:34,588 --> 01:09:40,368
kind of excuse me happens behind the

1623
01:09:36,359 --> 01:09:45,599
scenes and other organizations at NASA

1624
01:09:40,368 --> 01:09:47,248
yes resources how often do they have to

1625

01:09:45,599 --> 01:09:48,838
restore the food there's a resupply

1626
01:09:47,248 --> 01:09:51,630
vehicle that gets sent to the Space

1627
01:09:48,838 --> 01:09:53,309
Station probably and the mirror these

1628
01:09:51,630 --> 01:09:54,960
once every three months but it's

1629
01:09:53,309 --> 01:09:56,610
happening more and more frequently now

1630
01:09:54,960 --> 01:09:58,229
because we're getting more vehicles like

1631
01:09:56,609 --> 01:10:00,988
the SpaceX missions that are going up

1632
01:09:58,229 --> 01:10:03,780
there Cygnus Blue Origin things like

1633
01:10:00,988 --> 01:10:07,759
that so frequently but it's not always

1634
01:10:03,779 --> 01:10:10,800
just food it's other stuff too yeah

1635
01:10:07,760 --> 01:10:13,619
that's that are up there at any time do

1636
01:10:10,800 --> 01:10:15,389
they consider I now have to sort of be

1637
01:10:13,618 --> 01:10:18,328
cross-trained I understand that that's

1638
01:10:15,389 --> 01:10:21,359
right but do they do we cooperate in

1639
01:10:18,328 --> 01:10:24,299

terms of the complement that's up there

1640

01:10:21,359 --> 01:10:25,469

at any given time that has complement

1641

01:10:24,300 --> 01:10:28,170

the other people that are

1642

01:10:25,469 --> 01:10:30,750

they're something were to go wrong we

1643

01:10:28,170 --> 01:10:34,230

need the right people to be able to

1644

01:10:30,750 --> 01:10:38,850

handle back tire guards of who's in the

1645

01:10:34,229 --> 01:10:41,009

rotation kind of distill it a little bit

1646

01:10:38,850 --> 01:10:43,770

what thought is given to the crew

1647

01:10:41,010 --> 01:10:45,930

compliment on the ISS and what skills

1648

01:10:43,770 --> 01:10:48,510

they have in any given time if something

1649

01:10:45,930 --> 01:10:49,860

were to go wrong the the best answer to

1650

01:10:48,510 --> 01:10:51,449

that question is if something were to go

1651

01:10:49,859 --> 01:10:53,159

wrong it's these people on the ground

1652

01:10:51,448 --> 01:10:54,809

here that are going to take care of it

1653

01:10:53,159 --> 01:10:57,149

the astronauts may be pushing some

1654
01:10:54,810 --> 01:10:58,739
buttons for them may be doing some

1655
01:10:57,149 --> 01:10:59,219
things that they have to do hands-on in

1656
01:10:58,738 --> 01:11:02,129
space

1657
01:10:59,219 --> 01:11:03,600
but these people here in in Houston and

1658
01:11:02,130 --> 01:11:05,699
in Moscow and in the Mission Control

1659
01:11:03,600 --> 01:11:07,770
centers are the experts they're the ones

1660
01:11:05,698 --> 01:11:10,619
who are going to be reacting in care of

1661
01:11:07,770 --> 01:11:13,830
emergency situations as far as the crew

1662
01:11:10,619 --> 01:11:17,579
complement onboard I don't know exactly

1663
01:11:13,829 --> 01:11:20,579
how the crew is selected but I do know

1664
01:11:17,579 --> 01:11:24,569
that there is always an equal number of

1665
01:11:20,579 --> 01:11:26,670
Russian and non-russian members of the

1666
01:11:24,569 --> 01:11:28,649
space station crew and they alternate

1667
01:11:26,670 --> 01:11:31,920
between a Russian commander and a non

1668
01:11:28,649 --> 01:11:34,349
Russian commander so not necessarily

1669
01:11:31,920 --> 01:11:36,329
talking about the skills and such but a

1670
01:11:34,350 --> 01:12:01,020
little bit of how the crew is selected

1671
01:11:36,329 --> 01:12:02,789
in general it's a political thing when

1672
01:12:01,020 --> 01:12:04,860
they go up into space but they are also

1673
01:12:02,789 --> 01:12:07,109
understand that they are not the experts

1674
01:12:04,859 --> 01:12:09,389
of what needs to happen with the system

1675
01:12:07,109 --> 01:12:13,380
they always defer to the folks in this

1676
01:12:09,390 --> 01:12:14,610
room to take care of stuff in general

1677
01:12:13,380 --> 01:12:16,529
that's the answer sometimes that's not

1678
01:12:14,609 --> 01:12:18,869
to know them from being very cocky sell

1679
01:12:16,529 --> 01:12:20,939
them short people so but in general

1680
01:12:18,869 --> 01:12:22,529
that's the answer and would it be true

1681
01:12:20,939 --> 01:12:25,919
that for the Russian portion of the

1682

01:12:22,529 --> 01:12:28,349
space station that it's the people

1683
01:12:25,920 --> 01:12:30,569
Russia who would be on the ground yes

1684
01:12:28,350 --> 01:12:32,130
yeah so it's the same thing for the

1685
01:12:30,569 --> 01:12:33,630
Russian person this portion of the space

1686
01:12:32,130 --> 01:12:35,340
station it's the Russian flight control

1687
01:12:33,630 --> 01:12:38,069
team that are the experts for those

1688
01:12:35,340 --> 01:12:39,810
systems ok I'm going to go through and

1689
01:12:38,069 --> 01:12:42,059
talk about James Webb because it's

1690
01:12:39,810 --> 01:12:44,100
happening here in various language so

1691
01:12:42,060 --> 01:12:46,230
lots of satellites have their own

1692
01:12:44,100 --> 01:12:51,030
Mission Control Center just like James

1693
01:12:46,229 --> 01:12:52,319
Webb if you I don't know if it's open to

1694
01:12:51,029 --> 01:12:54,899
the public but it's just right upstairs

1695
01:12:52,319 --> 01:12:59,189
probably not open to the public so don't

1696
01:12:54,899 --> 01:13:02,309

try to go out there this is a picture I

1697

01:12:59,189 --> 01:13:04,259

took from the internet so Serge JWST

1698

01:13:02,310 --> 01:13:07,130

Mission Operations Center in YouTube can

1699

01:13:04,260 --> 01:13:09,360

look at this picture and others like it

1700

01:13:07,130 --> 01:13:11,368

this is the Mission Operations Center

1701

01:13:09,359 --> 01:13:13,408

you notice one thing that's really cool

1702

01:13:11,368 --> 01:13:14,189

that I thought was awesome is all this

1703

01:13:13,408 --> 01:13:16,769

back here

1704

01:13:14,189 --> 01:13:18,899

those are windows that look out right

1705

01:13:16,770 --> 01:13:21,440

over Wyman Park it's really pretty

1706

01:13:18,899 --> 01:13:23,819

watch the trees change and the wind

1707

01:13:21,439 --> 01:13:27,988

awesome compared to the Mission Control

1708

01:13:23,819 --> 01:13:30,750

Center piece and there's no windows so

1709

01:13:27,988 --> 01:13:33,329

this is where the quiz part comes in I'm

1710

01:13:30,750 --> 01:13:35,729

going to relate the flight control

1711
01:13:33,329 --> 01:13:36,779
positions on the ISS to what we're doing

1712
01:13:35,729 --> 01:13:41,269
on James Webb

1713
01:13:36,779 --> 01:13:43,500
so who remembers what Spartan does our

1714
01:13:41,270 --> 01:13:45,330
good yeah so they're in charge of the

1715
01:13:43,500 --> 01:13:48,539
solar rates and the electrical power on

1716
01:13:45,329 --> 01:13:52,289
James Webb we have a similar position

1717
01:13:48,539 --> 01:13:55,649
called EPS and TCS not as cool in the

1718
01:13:52,289 --> 01:13:57,960
afternoon that means for electrical

1719
01:13:55,649 --> 01:13:58,710
power subsystem and thermal control

1720
01:13:57,960 --> 01:14:00,239
subsystem

1721
01:13:58,710 --> 01:14:03,539
so it's the same sort of job that

1722
01:14:00,238 --> 01:14:06,439
Spartan did only on James Webb we also

1723
01:14:03,539 --> 01:14:09,029
have ADCO what is Edco do on ISS

1724
01:14:06,439 --> 01:14:10,618
attitude good we have something similar

1725
01:14:09,029 --> 01:14:13,139
on James Webb called

1726
01:14:10,618 --> 01:14:15,420
ACS and proc it's the attitude control

1727
01:14:13,139 --> 01:14:17,368
system and propulsion so again they're

1728
01:14:15,420 --> 01:14:19,199
in charge of the attitude of the

1729
01:14:17,368 --> 01:14:22,229
spacecraft but also the thrusters that

1730
01:14:19,198 --> 01:14:25,488
keep it where we want it to be then we

1731
01:14:22,229 --> 01:14:25,488
have ethos what it goes to

1732
01:14:25,559 --> 01:14:30,360
mental control what do you think they do

1733
01:14:27,359 --> 01:14:33,929
for James Webb nothing because there's

1734
01:14:30,359 --> 01:14:35,759
no people in James way happy livable

1735
01:14:33,929 --> 01:14:36,960
environment so we don't have the

1736
01:14:35,760 --> 01:14:43,440
equivalent of an eNOS

1737
01:14:36,960 --> 01:14:47,069
we do have Chronos what a grimace do the

1738
01:14:43,439 --> 01:14:49,348
communications and the video and onboard

1739

01:14:47,069 --> 01:14:50,939
computers so on James man we've taken

1740
01:14:49,349 --> 01:14:53,788
all of those things and split them up

1741
01:14:50,939 --> 01:14:55,469
into two positions we have flight

1742
01:14:53,788 --> 01:14:59,488
software and command and data handling

1743
01:14:55,469 --> 01:15:00,809
which are again are the sending commands

1744
01:14:59,488 --> 01:15:03,118
to the spacecraft and how they get

1745
01:15:00,809 --> 01:15:05,010
handled within the spacecraft and then

1746
01:15:03,118 --> 01:15:06,929
the telemetry that comes back down from

1747
01:15:05,010 --> 01:15:11,489
the spacecraft and then communications

1748
01:15:06,929 --> 01:15:14,609
which is how that telemetry comes down

1749
01:15:11,488 --> 01:15:17,279
and how that those commands and get up

1750
01:15:14,609 --> 01:15:20,038
to the space station so those are those

1751
01:15:17,279 --> 01:15:24,359
are the subject matter experts that we

1752
01:15:20,038 --> 01:15:34,050
have for James Webb in the controller we

1753
01:15:24,359 --> 01:15:35,308

also have science instruments so you

1754

01:15:34,050 --> 01:15:37,079

guys have you come to these lectures

1755

01:15:35,309 --> 01:15:38,779

elect you probably are familiar with the

1756

01:15:37,078 --> 01:15:41,069

science instruments I'm James Webb I

1757

01:15:38,779 --> 01:15:43,800

pretended to have familiarity with them

1758

01:15:41,069 --> 01:15:47,210

by knowing the acronyms such as the near

1759

01:15:43,800 --> 01:15:50,788

infrared imager and slit list

1760

01:15:47,210 --> 01:15:53,010

spectrograph yeah mirror and grade

1761

01:15:50,788 --> 01:16:06,979

camera the near infrared spectrograph

1762

01:15:53,010 --> 01:16:08,789

the infrared sensor sensor those are the

1763

01:16:06,979 --> 01:16:10,738

science instruments that are onboard

1764

01:16:08,788 --> 01:16:12,538

James Webb then each one of those

1765

01:16:10,738 --> 01:16:14,000

science instruments has a team of people

1766

01:16:12,538 --> 01:16:15,590

throughout the world who are

1767

01:16:14,000 --> 01:16:17,659

charge and making sure the instrument is

1768
01:16:15,590 --> 01:16:19,550
calibrated making sure we can take the

1769
01:16:17,659 --> 01:16:21,829
best science that we can from it that

1770
01:16:19,550 --> 01:16:23,840
the astronomical community knows how to

1771
01:16:21,829 --> 01:16:26,659
use it a whole contingent of people

1772
01:16:23,840 --> 01:16:30,590
behind each one of those science

1773
01:16:26,659 --> 01:16:34,809
instruments we also have here at STScI

1774
01:16:30,590 --> 01:16:37,940
the people who are in charge of making

1775
01:16:34,810 --> 01:16:40,430
sure everything from the astronauts

1776
01:16:37,939 --> 01:16:43,759
telling us what they want to look at all

1777
01:16:40,430 --> 01:16:46,369
the way to sending those commands or

1778
01:16:43,760 --> 01:16:48,590
sending that information up to the state

1779
01:16:46,369 --> 01:16:49,760
up to the spacecraft making the

1780
01:16:48,590 --> 01:16:53,000
spacecraft point where we want it to

1781
01:16:49,760 --> 01:16:54,980
point taking the images gathering that

1782
01:16:53,000 --> 01:16:57,710
data sending it down and getting it back

1783
01:16:54,979 --> 01:17:00,259
out to the astronomical community those

1784
01:16:57,710 --> 01:17:01,970
people also work here will work here at

1785
01:17:00,260 --> 01:17:04,070
Space Telescope in the silent Operations

1786
01:17:01,970 --> 01:17:08,180
Center so we have the proposal planning

1787
01:17:04,069 --> 01:17:09,979
subsystem which is the suite of tools

1788
01:17:08,180 --> 01:17:11,690
that allow the astronomers to tell us

1789
01:17:09,979 --> 01:17:13,519
what they want to look at we take that

1790
01:17:11,689 --> 01:17:16,250
information we put it on a rough

1791
01:17:13,520 --> 01:17:20,120
schedule we take that rough schedule and

1792
01:17:16,250 --> 01:17:23,420
refine it a couple I think like 10 days

1793
01:17:20,119 --> 01:17:25,849
at a time we've refined the schedule to

1794
01:17:23,420 --> 01:17:28,220
make sure we're taking the observations

1795
01:17:25,850 --> 01:17:31,130
the astronauts want to look at and then

1796

01:17:28,220 --> 01:17:32,840
we package up that data and hand it off

1797
01:17:31,130 --> 01:17:36,460
to get sent up to the spacecraft where

1798
01:17:32,840 --> 01:17:36,460
those observations get executed

1799
01:17:42,159 --> 01:17:53,329
oh well now I'm talking about it

1800
01:17:45,079 --> 01:17:57,559
stronger so so the see now you threw me

1801
01:17:53,329 --> 01:17:59,210
off the so the data gets sent up the the

1802
01:17:57,560 --> 01:18:00,890
observations we want to take get sent up

1803
01:17:59,210 --> 01:18:03,350
to the spacecraft it takes the

1804
01:18:00,890 --> 01:18:05,420
observations and they get sent back down

1805
01:18:03,350 --> 01:18:07,880
to the data management subsystem which

1806
01:18:05,420 --> 01:18:09,800
takes all those ones and zeroes that

1807
01:18:07,880 --> 01:18:11,750
come down from space and turns them into

1808
01:18:09,800 --> 01:18:14,180
the science that the app that the

1809
01:18:11,750 --> 01:18:17,270
astronomers haha but the astronomers

1810
01:18:14,180 --> 01:18:18,920

used to do all of it turns it into the

1811

01:18:17,270 --> 01:18:21,260

data that the astronomers use to do all

1812

01:18:18,920 --> 01:18:23,180

of their science we also have the

1813

01:18:21,260 --> 01:18:26,000

project reference database which is

1814

01:18:23,180 --> 01:18:27,920

basically just a database of information

1815

01:18:26,000 --> 01:18:28,369

that each of these subsystems pull from

1816

01:18:27,920 --> 01:18:29,480

to make

1817

01:18:28,369 --> 01:18:31,340

sure we're all using the same

1818

01:18:29,479 --> 01:18:34,489

information and then we have the

1819

01:18:31,340 --> 01:18:37,970

wavefront sensing and control subsystem

1820

01:18:34,489 --> 01:18:40,939

that basically makes sure the spacecraft

1821

01:18:37,970 --> 01:18:43,220

is in focus so each one of the mirrors

1822

01:18:40,939 --> 01:18:45,500

on James Webb can articulate on its own

1823

01:18:43,220 --> 01:18:47,420

to make sure that the spacecraft is

1824

01:18:45,500 --> 01:18:49,220

always in focus so we don't run into

1825
01:18:47,420 --> 01:18:52,399
focus issues that I hear sometimes

1826
01:18:49,220 --> 01:18:55,970
happen on spacecraft sometimes so these

1827
01:18:52,399 --> 01:18:58,819
are the kind of behind-the-scenes things

1828
01:18:55,970 --> 01:19:01,610
that happen here at Space Telescope to

1829
01:18:58,819 --> 01:19:05,059
make James Webb possible so we have the

1830
01:19:01,609 --> 01:19:07,039
onboard systems to operate the actual

1831
01:19:05,060 --> 01:19:08,600
spacecraft we have the teams that

1832
01:19:07,039 --> 01:19:11,600
operate the science instruments and then

1833
01:19:08,600 --> 01:19:16,789
the teams here at Ft that make all of

1834
01:19:11,600 --> 01:19:19,810
the science possible and that's it so

1835
01:19:16,789 --> 01:19:19,810
are there any more questions

1836
01:19:29,960 --> 01:19:35,310
okay you guys had a lot of questions who

1837
01:19:33,630 --> 01:19:38,069
during her talk but I'm sure there are

1838
01:19:35,310 --> 01:19:43,500
more because that's just a body as you

1839
01:19:38,069 --> 01:19:45,869
are I'm finally accessed what is the

1840
01:19:43,500 --> 01:19:49,529
source of the object track information

1841
01:19:45,869 --> 01:19:51,329
that's used for that position it yeah I

1842
01:19:49,529 --> 01:19:52,710
assess what is the source of the object

1843
01:19:51,329 --> 01:19:54,449
tracking information that's used for

1844
01:19:52,710 --> 01:19:57,750
collision avoidance we work with the Air

1845
01:19:54,449 --> 01:19:59,729
Force there knows where lots and lots of

1846
01:19:57,750 --> 01:20:01,829
stuff in spaces so the trajectory

1847
01:19:59,729 --> 01:20:03,569
Operations Officer works in collection

1848
01:20:01,829 --> 01:20:05,399
with them and sometimes it's the Air

1849
01:20:03,569 --> 01:20:06,960
Force calling us and saying hey there's

1850
01:20:05,399 --> 01:20:26,849
a thing in the way you should think

1851
01:20:06,960 --> 01:20:40,319
about moving out of the way and then

1852
01:20:26,850 --> 01:20:48,030
they just give us the information way to

1853

01:20:40,319 --> 01:20:50,090
bring home something that's really acute

1854
01:20:48,029 --> 01:20:53,219
like appendicitis I don't know for sure

1855
01:20:50,090 --> 01:20:56,069
is really kind of critical thing it

1856
01:20:53,220 --> 01:20:59,159
takes a finite amount of time to get the

1857
01:20:56,069 --> 01:21:00,929
astronauts down I think why well I'd I'm

1858
01:20:59,159 --> 01:21:02,699
not sure what the fastest amount of time

1859
01:21:00,930 --> 01:21:04,409
is but usually when they leave the space

1860
01:21:02,699 --> 01:21:06,569
station they can get home and about they

1861
01:21:04,409 --> 01:21:08,970
usually get home in three days it can be

1862
01:21:06,569 --> 01:21:10,319
expedited I'm not sure how fast and

1863
01:21:08,970 --> 01:21:11,070
there's only a mini huge like

1864
01:21:10,319 --> 01:21:14,429
appendicitis

1865
01:21:11,069 --> 01:21:16,710
I'm actually really sure what they would

1866
01:21:14,430 --> 01:21:19,610
do probably something very theatrical

1867
01:21:16,710 --> 01:21:19,609

and heroic

1868

01:21:21,529 --> 01:21:25,829
but something that was less

1869

01:21:23,578 --> 01:21:27,898
time-sensitive they can absolutely send

1870

01:21:25,828 --> 01:21:32,908
the crew back at any time they are sent

1871

01:21:27,899 --> 01:21:35,429
a medical doctor roughly yeah I know for

1872

01:21:32,908 --> 01:21:37,708
sure for the space shuttle crews I don't

1873

01:21:35,429 --> 01:21:39,269
know I would imagine there have been

1874

01:21:37,708 --> 01:21:53,578
medical doctors that have been sent to

1875

01:21:39,269 --> 01:21:57,359
ISS but I don't know for a fact what

1876

01:21:53,578 --> 01:21:59,518
would that look like so this part of the

1877

01:21:57,359 --> 01:22:27,029
games lab is about the size of a tennis

1878

01:21:59,519 --> 01:22:33,989
court and the redundancy is there in the

1879

01:22:27,029 --> 01:22:35,729
web I don't know how many levels of

1880

01:22:33,988 --> 01:22:39,048
redundancy there are in James Webb my

1881

01:22:35,729 --> 01:22:40,168
guess is that it's probably two

1882
01:22:39,048 --> 01:22:41,788
fault-tolerant

1883
01:22:40,168 --> 01:22:47,458
for the systems which means it can

1884
01:22:41,788 --> 01:22:50,099
handle two things happening wrong to the

1885
01:22:47,458 --> 01:22:50,568
same component I don't know that for a

1886
01:22:50,099 --> 01:22:54,628
fact

1887
01:22:50,569 --> 01:22:55,619
that's my guess don't work with the

1888
01:22:54,628 --> 01:22:58,048
Hubble Space Telescope

1889
01:22:55,618 --> 01:22:59,458
we of course have two sides to the Tron

1890
01:22:58,048 --> 01:23:01,738
tree of an a side to each side of the

1891
01:22:59,458 --> 01:23:05,719
DSi it shorts out we can switch over the

1892
01:23:01,738 --> 01:23:05,718
B side with it with a minimal

1893
01:23:06,840 --> 01:23:11,760
you know the both sides failed on the

1894
01:23:10,109 --> 01:23:14,779
whole space telescope then we had to

1895
01:23:11,760 --> 01:23:18,869
repair them during servicing missions

1896
01:23:14,779 --> 01:23:20,960
like for example this I CDH failed for

1897
01:23:18,869 --> 01:23:23,309
its very first time after what 18 years

1898
01:23:20,960 --> 01:23:26,699
and we actually delayed servicing

1899
01:23:23,310 --> 01:23:28,680
mission 4 so you could replace placed

1900
01:23:26,699 --> 01:23:30,720
that and so we would have redundancy in

1901
01:23:28,680 --> 01:23:32,670
there so I mean they're very careful

1902
01:23:30,720 --> 01:23:39,270
about having a certain level of

1903
01:23:32,670 --> 01:23:40,590
redundancy but it's common practice when

1904
01:23:39,270 --> 01:23:44,340
you make a spacecraft to at least have

1905
01:23:40,590 --> 01:23:46,110
one level of redundancy and four really

1906
01:23:44,340 --> 01:23:47,430
important systems like your power system

1907
01:23:46,109 --> 01:23:55,979
of your communication system is

1908
01:23:47,430 --> 01:24:00,930
generally 2 or 3 radiation hazard in

1909
01:23:55,979 --> 01:24:04,379
terms of itself the radiation hazards

1910

01:24:00,930 --> 01:24:06,000
for the equipment on web itself I did

1911
01:24:04,380 --> 01:24:08,690
not talk about it because I don't know

1912
01:24:06,000 --> 01:24:08,689
that much about it

1913
01:24:12,500 --> 01:24:20,300
I'm not sure I do political events here

1914
01:24:18,350 --> 01:24:22,280
on the surface of the earth affect the

1915
01:24:20,300 --> 01:24:28,880
decision-making process for what happens

1916
01:24:22,279 --> 01:24:31,819
on Space Station's process for the space

1917
01:24:28,880 --> 01:24:34,489
station it's interesting because the

1918
01:24:31,819 --> 01:24:36,199
politics on earth the ISS is sort of

1919
01:24:34,489 --> 01:24:38,359
immune to politics suckers like right

1920
01:24:36,199 --> 01:24:41,420
now there's a lot of let's say

1921
01:24:38,359 --> 01:24:44,089
contention between Russia and the US on

1922
01:24:41,420 --> 01:24:45,890
a political scale but the onboard

1923
01:24:44,090 --> 01:24:48,230
operations of the ISS are progressing

1924
01:24:45,890 --> 01:24:49,520

normally I know for a fact that the

1925

01:24:48,229 --> 01:24:51,469
Mission Control centers are still

1926

01:24:49,520 --> 01:24:53,600
working in tandem I have friends who are

1927

01:24:51,470 --> 01:24:54,949
over there right now who are perfectly

1928

01:24:53,600 --> 01:25:02,690
happy at work and then a little weary

1929

01:24:54,949 --> 01:25:04,840
when they do I assess has been up there

1930

01:25:02,689 --> 01:25:07,609
for quite some time and and a lot of

1931

01:25:04,840 --> 01:25:09,710
turbulent things have happened during

1932

01:25:07,609 --> 01:25:12,229
that time span and it never had an

1933

01:25:09,710 --> 01:25:14,510
effect really on the decision-making

1934

01:25:12,229 --> 01:25:16,639
process the number one most important

1935

01:25:14,510 --> 01:25:17,750
thing on the ISS is the crew the second

1936

01:25:16,640 --> 01:25:19,579
most important thing is the vehicle

1937

01:25:17,750 --> 01:25:22,399
itself and that's just a tenant that's

1938

01:25:19,579 --> 01:25:24,829
hold that's held true regardless of who

1939
01:25:22,399 --> 01:25:27,649
happens to be the president or what an

1940
01:25:24,829 --> 01:25:29,840
embassy happens to be doing so it's it's

1941
01:25:27,649 --> 01:25:38,469
blissfully immuned does it have its own

1942
01:25:29,840 --> 01:25:38,470
governance or capsule and then hopefully

1943
01:25:43,239 --> 01:25:46,739
it's actually think it's a really cool

1944
01:25:45,619 --> 01:25:48,329
thing it's an

1945
01:25:46,739 --> 01:25:50,489
it truly is an international endeavor

1946
01:25:48,329 --> 01:25:53,340
and it couldn't be done if one if even

1947
01:25:50,489 --> 01:25:56,069
is one country pulled out of the ISS it

1948
01:25:53,340 --> 01:26:00,630
wouldn't survive anymore so I think it's

1949
01:25:56,069 --> 01:26:04,069
a really cool thing tell us but what

1950
01:26:00,630 --> 01:26:06,510
you're doing now I forgot the exact time

1951
01:26:04,069 --> 01:26:08,789
sure I'm the systems integration and

1952
01:26:06,510 --> 01:26:10,470
test engineer so on that last slide that

1953
01:26:08,789 --> 01:26:12,239
I was talking about those are all the

1954
01:26:10,470 --> 01:26:15,140
subsystems for the science and operation

1955
01:26:12,239 --> 01:26:18,090
center so my team and I make sure that

1956
01:26:15,140 --> 01:26:20,220
those subsystems are going to be fully

1957
01:26:18,090 --> 01:26:23,250
functional by the time James James one

1958
01:26:20,220 --> 01:26:27,150
of launches so we are making sure

1959
01:26:23,250 --> 01:26:30,989
everything from the software that the

1960
01:26:27,149 --> 01:26:33,449
advent of stronger put in the their data

1961
01:26:30,989 --> 01:26:35,819
into to the flight operation system that

1962
01:26:33,449 --> 01:26:39,050
actually commands the spacecraft my team

1963
01:26:35,819 --> 01:26:41,299
is responsible for making sure that it's

1964
01:26:39,050 --> 01:26:44,570
going to work

1965
01:26:41,300 --> 01:26:47,100
we just terrifying but that's what we do

1966
01:26:44,569 --> 01:26:49,289
and we work in tandem with the people

1967

01:26:47,100 --> 01:26:50,910
who are developing the systems to make

1968
01:26:49,289 --> 01:26:53,789
sure that they work the way we're

1969
01:26:50,909 --> 01:26:56,449
supposed to and just know we astronomers

1970
01:26:53,789 --> 01:26:56,449
don't care

1971
01:27:02,819 --> 01:27:08,309
[Music]

1972
01:27:08,988 --> 01:27:18,209
related to the question what was your

1973
01:27:11,760 --> 01:27:21,780
career packet Houston eventually so my

1974
01:27:18,210 --> 01:27:24,090
career path was I really wanted to be

1975
01:27:21,779 --> 01:27:27,179
that from when I was a kid I've never

1976
01:27:24,090 --> 01:27:30,690
really got over that but then got more

1977
01:27:27,180 --> 01:27:31,409
realistic about it and I like studied

1978
01:27:30,689 --> 01:27:33,809
aeronautical and astronautical

1979
01:27:31,409 --> 01:27:37,529
engineering at Purdue University and

1980
01:27:33,810 --> 01:27:39,300
while I was at Purdue I got at the time

1981
01:27:37,529 --> 01:27:40,710

it was called a co-op which it's kind of

1982

01:27:39,300 --> 01:27:43,170

like a work-study program where I would

1983

01:27:40,710 --> 01:27:44,460

alternate working one semester and then

1984

01:27:43,170 --> 01:27:46,230

going to school another semester and

1985

01:27:44,460 --> 01:27:47,850

then working and semester and going to

1986

01:27:46,229 --> 01:27:50,909

school and alternating until I graduated

1987

01:27:47,850 --> 01:27:54,570

and I got my co-op position with knock

1988

01:27:50,909 --> 01:27:56,399

side down in in Houston so starting my

1989

01:27:54,569 --> 01:27:58,829

sophomore year I would go work down in

1990

01:27:56,399 --> 01:28:00,389

Houston every other semester getting job

1991

01:27:58,829 --> 01:28:02,250

skills and training and kind of seeing

1992

01:28:00,390 --> 01:28:04,440

where I fit in in the mix of everything

1993

01:28:02,250 --> 01:28:07,800

so that by the time I graduated I had a

1994

01:28:04,439 --> 01:28:10,349

full-time job waiting for me down in

1995

01:28:07,800 --> 01:28:13,250

Houston I was there for about four years

1996
01:28:10,350 --> 01:28:16,699
and Mike hey Houston so I wanted to move

1997
01:28:13,250 --> 01:28:18,930
and I found a job up here I am a

1998
01:28:16,698 --> 01:28:20,219
aerospace engineer who doesn't

1999
01:28:18,930 --> 01:28:22,170
particularly want to work for a defense

2000
01:28:20,219 --> 01:28:24,719
contractor so it really limits my

2001
01:28:22,170 --> 01:28:26,340
options so I had been a civil servant

2002
01:28:24,719 --> 01:28:28,980
for the government down in Houston

2003
01:28:26,340 --> 01:28:31,829
I found this position here literally by

2004
01:28:28,979 --> 01:28:33,149
typing aerospace jobs state because I

2005
01:28:31,829 --> 01:28:35,670
just wanted to leave Houston because

2006
01:28:33,149 --> 01:28:37,799
it's not my favorite place awesome work

2007
01:28:35,670 --> 01:28:40,969
it loves my job I just didn't want to be

2008
01:28:37,800 --> 01:28:43,409
there anymore so I found this job I

2009
01:28:40,969 --> 01:28:45,090
applied they brought me up for an

2010
01:28:43,409 --> 01:28:46,590
interview I convinced him I vaguely know

2011
01:28:45,090 --> 01:28:49,670
what I'm talking about and then they

2012
01:28:46,590 --> 01:28:49,670
hired me so I came up here

2013
01:28:53,500 --> 01:28:58,689
I have to cut off questions at 9:30

2014
01:28:56,310 --> 01:29:02,080
araignee is not in the building

2015
01:28:58,689 --> 01:29:04,000
so I presume there will be no observing

2016
01:29:02,079 --> 01:29:07,239
cat-themed aerospace ran observatories

2017
01:29:04,000 --> 01:29:10,920
name join us next month for active

2018
01:29:07,239 --> 01:29:10,920
luminous variables and large

2019
01:29:12,720 --> 01:29:23,930
[Applause]