
TCH
XIT

1
00:00:06,470 --> 00:00:03,909
hi my name is dan burbank i'm

2
00:00:08,950 --> 00:00:06,480
a crew member from expedition 29 and

3
00:00:11,589 --> 00:00:08,960
i've been the commander of expedition 30

4
00:00:14,470 --> 00:00:11,599
uh since uh five days or four days i

5
00:00:17,349 --> 00:00:14,480
guess after we arrived in mid-november

6
00:00:19,830 --> 00:00:17,359
and um right now i'm getting ready as

7
00:00:22,230 --> 00:00:19,840
are my uh my two soyuz crewmates anton

8
00:00:24,230 --> 00:00:22,240
shkaplerov and anatoly ivanishin uh

9
00:00:25,109 --> 00:00:24,240
returned to return back to earth after

10
00:00:27,589 --> 00:00:25,119
um

11
00:00:31,349 --> 00:00:27,599
uh more than five months living aboard

12
00:00:33,110 --> 00:00:31,359
this spectacular space station and um

13
00:00:35,830 --> 00:00:33,120

it's it's an interesting time right now

14
00:00:37,430 --> 00:00:35,840
to to to kind of take a few moments and

15
00:00:38,869 --> 00:00:37,440
think back at uh

16
00:00:41,190 --> 00:00:38,879
at what we've done what we've

17
00:00:43,430 --> 00:00:41,200
accomplished during the mission

18
00:00:45,029 --> 00:00:43,440
and kind of

19
00:00:47,670 --> 00:00:45,039
take a little bit of a break from the

20
00:00:49,990 --> 00:00:47,680
the hectic operations just to uh to

21
00:00:52,709 --> 00:00:50,000
reflect a little bit and um and i think

22
00:00:54,549 --> 00:00:52,719
it's really important uh for me to to

23
00:00:57,910 --> 00:00:54,559
kind of take stock of what we've done up

24
00:01:01,349 --> 00:00:57,920
here it has been a whirlwind it has been

25
00:01:03,349 --> 00:01:01,359
a head-spinning adventure and it's been

26
00:01:04,710 --> 00:01:03,359
exciting and uh wonderful right from the

27
00:01:06,230 --> 00:01:04,720
get-go

28
00:01:08,070 --> 00:01:06,240
when i um

29
00:01:11,270 --> 00:01:08,080
before i launched in this mission i i

30
00:01:13,109 --> 00:01:11,280
basically had three simple goals and the

31
00:01:13,990 --> 00:01:13,119
first one was to take good care of the

32
00:01:16,390 --> 00:01:14,000
crew

33
00:01:17,670 --> 00:01:16,400
and the second one was to take good care

34
00:01:19,109 --> 00:01:17,680
of the space station and all the

35
00:01:21,670 --> 00:01:19,119
hardware up here

36
00:01:23,670 --> 00:01:21,680
and the third one was to conduct as much

37
00:01:25,990 --> 00:01:23,680
research both scientific and

38
00:01:28,789 --> 00:01:26,000

technological as uh the space station

39
00:01:31,350 --> 00:01:28,799
was capable and as uh our crew

40
00:01:33,749 --> 00:01:31,360
was able to do and and i think in

41
00:01:35,749 --> 00:01:33,759
reflection now that we've done a a

42
00:01:38,310 --> 00:01:35,759
pretty good job of all three

43
00:01:40,310 --> 00:01:38,320
and uh from the uh from the start though

44
00:01:42,310 --> 00:01:40,320
we had a couple of challenges and i and

45
00:01:45,109 --> 00:01:42,320
i think one of the biggest ones was that

46
00:01:47,830 --> 00:01:45,119
we had a minimal overlap with uh with

47
00:01:49,030 --> 00:01:47,840
mike fossum sergey volkov and satoshi

48
00:01:51,670 --> 00:01:49,040
furukawa

49
00:01:53,270 --> 00:01:51,680
we had four days total with them to hand

50
00:01:56,069 --> 00:01:53,280
over to physically handover to learn the

51
00:02:00,149 --> 00:01:56,079
ropes about how to operate this uh this

52
00:02:02,310 --> 00:02:00,159
spaceship and um that in itself uh would

53
00:02:05,429 --> 00:02:02,320
have been a major challenge if it were

54
00:02:06,789 --> 00:02:05,439
not for the fact that the ground and uh

55
00:02:08,229 --> 00:02:06,799
and that crew

56
00:02:10,790 --> 00:02:08,239
were very clever and kind of thought

57
00:02:12,550 --> 00:02:10,800
outside the box and we

58
00:02:14,470 --> 00:02:12,560
basically spent a couple of months

59
00:02:16,309 --> 00:02:14,480
leading up to our launch

60
00:02:17,990 --> 00:02:16,319
talking with them getting video down

61
00:02:20,390 --> 00:02:18,000
links with them and doing i guess what

62
00:02:22,710 --> 00:02:20,400
i'd call a virtual handover learning all

63
00:02:23,430 --> 00:02:22,720

the ropes learning how to operate all

64
00:02:28,390 --> 00:02:23,440
the

65
00:02:30,150 --> 00:02:28,400
hardware on space station how to do even

66
00:02:31,670 --> 00:02:30,160
the mundane and routine things that we

67
00:02:34,630 --> 00:02:31,680
do on a daily basis

68
00:02:37,350 --> 00:02:34,640
and uh it basically set anton anatoly

69
00:02:39,830 --> 00:02:37,360
and i up uh for for success right from

70
00:02:42,070 --> 00:02:39,840
the get-go and it was in some ways maybe

71
00:02:44,390 --> 00:02:42,080
better than having two months of overlap

72
00:02:46,390 --> 00:02:44,400
with the crew because instead of getting

73
00:02:48,630 --> 00:02:46,400
a chance to see one thing

74
00:02:51,430 --> 00:02:48,640
one time while mike and i had the chance

75
00:02:54,070 --> 00:02:51,440
to chat about it um i could uh

76
00:02:55,670 --> 00:02:54,080
basically at my own pace over the course

77
00:02:58,630 --> 00:02:55,680
of several weeks leading up to launch

78
00:03:00,229 --> 00:02:58,640
review a videotape that he had made of

79
00:03:02,309 --> 00:03:00,239
say a repair

80
00:03:04,630 --> 00:03:02,319
on one of our regenerative eclipse

81
00:03:07,030 --> 00:03:04,640
environmental control system uh systems

82
00:03:09,509 --> 00:03:07,040
for example and so actually it was a

83
00:03:12,550 --> 00:03:09,519
very elegant and great way to get ready

84
00:03:15,190 --> 00:03:12,560
another challenge we had was that we had

85
00:03:17,350 --> 00:03:15,200
anton anatoly and i an extended uh

86
00:03:20,149 --> 00:03:17,360
period of three crew not quite as

87
00:03:22,550 --> 00:03:20,159
extended as mike and sergey and satoshi

88
00:03:24,869 --> 00:03:22,560

had but we still had a good five weeks

89
00:03:29,110 --> 00:03:24,879
plus uh with just the three of us uh

90
00:03:32,949 --> 00:03:29,120
knocking around this uh huge uh 360 feet

91
00:03:34,789 --> 00:03:32,959
wide 240 foot long space station and

92
00:03:36,149 --> 00:03:34,799
and that also

93
00:03:37,750 --> 00:03:36,159
if you're going to take the most

94
00:03:39,670 --> 00:03:37,760
advantage you can of the time that you

95
00:03:42,229 --> 00:03:39,680
got and do as much science that's a

96
00:03:44,710 --> 00:03:42,239
challenge in anybody's book

97
00:03:46,550 --> 00:03:44,720
another thing we had is in the in the

98
00:03:48,789 --> 00:03:46,560
time leading up to our launch

99
00:03:50,710 --> 00:03:48,799
the ground very wisely and the crew that

100
00:03:51,750 --> 00:03:50,720
was on board very very wisely and

101
00:03:53,509 --> 00:03:51,760
astutely

102
00:03:55,509 --> 00:03:53,519
took the time to put the space station

103
00:03:58,390 --> 00:03:55,519
in a good posture

104
00:04:00,550 --> 00:03:58,400
if there were to have been a delay in

105
00:04:02,309 --> 00:04:00,560
our launch such that we would have had

106
00:04:03,589 --> 00:04:02,319
no handover at all such that space

107
00:04:05,830 --> 00:04:03,599
station would have been unmanned for a

108
00:04:07,589 --> 00:04:05,840
period of time so a lot of preparations

109
00:04:09,750 --> 00:04:07,599
were made and all the systems across the

110
00:04:12,309 --> 00:04:09,760
space station to basically put it in a

111
00:04:13,589 --> 00:04:12,319
good posture so it could fly by itself

112
00:04:14,390 --> 00:04:13,599
under the guidance of all the folks on

113
00:04:16,870 --> 00:04:14,400

the ground

114
00:04:19,430 --> 00:04:16,880
uh without you know a crew to physically

115
00:04:21,590 --> 00:04:19,440
take care of things so we had some time

116
00:04:24,070 --> 00:04:21,600
to we we needed to spend a lot of time

117
00:04:25,830 --> 00:04:24,080
to back out of a lot of those uh those

118
00:04:27,670 --> 00:04:25,840
uh precautions and those system

119
00:04:30,230 --> 00:04:27,680
configurations that were done

120
00:04:32,469 --> 00:04:30,240
the other challenge is for me a long

121
00:04:35,030 --> 00:04:32,479
duration mission this was my first shot

122
00:04:37,430 --> 00:04:35,040
at that and i i'd flown twice on the

123
00:04:38,790 --> 00:04:37,440
space shuttle and knew how we we

124
00:04:39,990 --> 00:04:38,800
operated on the shuttle for a two week

125
00:04:41,909 --> 00:04:40,000
mission but

126
00:04:43,670 --> 00:04:41,919
that doesn't necessarily adequately

127
00:04:46,150 --> 00:04:43,680
reflect what it's like to be six months

128
00:04:48,070 --> 00:04:46,160
up here and for anton and anatoly this

129
00:04:50,629 --> 00:04:48,080
was their first space flight so i looked

130
00:04:51,990 --> 00:04:50,639
at that kind of as a challenge for us

131
00:04:53,670 --> 00:04:52,000
and um

132
00:04:56,390 --> 00:04:53,680
probably lastly and maybe most

133
00:04:59,030 --> 00:04:56,400
importantly this is a nearly a million

134
00:05:02,310 --> 00:04:59,040
pound space station it is unbelievably

135
00:05:03,909 --> 00:05:02,320
expansive unbelievably complicated

136
00:05:05,830 --> 00:05:03,919
and uh just

137
00:05:07,270 --> 00:05:05,840
uh anybody on a good day with an

138
00:05:08,870 --> 00:05:07,280

experienced crew operating all the

139
00:05:11,430 --> 00:05:08,880
things and being prepared if there were

140
00:05:13,029 --> 00:05:11,440
to uh be some sort of a serious

141
00:05:15,909 --> 00:05:13,039
malfunction being prepared to deal with

142
00:05:17,029 --> 00:05:15,919
that that was also a big challenge for

143
00:05:21,990 --> 00:05:17,039
us

144
00:05:23,909 --> 00:05:22,000
is uh we were blessed we had a wonderful

145
00:05:26,230 --> 00:05:23,919
crew a great crew we're all good good

146
00:05:28,230 --> 00:05:26,240
friends best of friends now and in very

147
00:05:29,670 --> 00:05:28,240
good friends before we launched anton

148
00:05:33,350 --> 00:05:29,680
anatoly and i trained for a couple of

149
00:05:35,270 --> 00:05:33,360
years together and uh and don pettit and

150
00:05:37,510 --> 00:05:35,280
i have known each other for quite a long

151
00:05:38,390 --> 00:05:37,520
time um andre kuipers from the

152
00:05:41,270 --> 00:05:38,400
netherlands

153
00:05:42,950 --> 00:05:41,280
um and oleg kononenko now those three

154
00:05:44,550 --> 00:05:42,960
are the crew members that came up in the

155
00:05:46,950 --> 00:05:44,560
the soyuz that joined us in late

156
00:05:49,189 --> 00:05:46,960
december um everybody phenomenally

157
00:05:52,469 --> 00:05:49,199
talented great personalities get along

158
00:05:55,110 --> 00:05:52,479
wonderfully and i think all of our

159
00:05:57,830 --> 00:05:55,120
strengths play very nicely against our

160
00:06:01,110 --> 00:05:57,840
respective weaknesses so all in all

161
00:06:02,550 --> 00:06:01,120
i couldn't have asked for a better team

162
00:06:04,309 --> 00:06:02,560
and additionally

163
00:06:06,550 --> 00:06:04,319

on the plus side we have wonderful

164
00:06:08,390 --> 00:06:06,560
hardware it amazes me when i sit and i

165
00:06:09,430 --> 00:06:08,400
look at this incredible space station i

166
00:06:12,230 --> 00:06:09,440
think about

167
00:06:15,110 --> 00:06:12,240
all the time and effort and in brain

168
00:06:16,950 --> 00:06:15,120
power that went in to anticipating all

169
00:06:18,629 --> 00:06:16,960
the possible things all the connections

170
00:06:20,469 --> 00:06:18,639
between the various modules between the

171
00:06:23,270 --> 00:06:20,479
various hardware software connections

172
00:06:25,110 --> 00:06:23,280
physical connections and uh and make it

173
00:06:28,790 --> 00:06:25,120
in such a way that it was robust enough

174
00:06:30,870 --> 00:06:28,800
to operate so well and so that was a

175
00:06:32,950 --> 00:06:30,880
huge plus and probably the biggest plus

176
00:06:35,350 --> 00:06:32,960
of all are the tens of thousands of

177
00:06:37,909 --> 00:06:35,360
people all around the world from the 16

178
00:06:39,830 --> 00:06:37,919
partner nations that have that have

179
00:06:41,110 --> 00:06:39,840
built the space station

180
00:06:42,550 --> 00:06:41,120
we have got

181
00:06:44,230 --> 00:06:42,560
at the leading edge of that from our

182
00:06:46,070 --> 00:06:44,240
perspective as crew we've got the

183
00:06:48,150 --> 00:06:46,080
control center in houston

184
00:06:49,589 --> 00:06:48,160
mission control we have mission control

185
00:06:51,430 --> 00:06:49,599
in moscow

186
00:06:52,469 --> 00:06:51,440
we have the u.s

187
00:06:54,790 --> 00:06:52,479
segments

188
00:06:56,950 --> 00:06:54,800

leed science center in huntsville we

189
00:06:59,430 --> 00:06:56,960
have the japanese aerospace exploration

190
00:07:01,990 --> 00:06:59,440
agency center in scuba japan

191
00:07:04,150 --> 00:07:02,000
and we have in munich the european space

192
00:07:05,589 --> 00:07:04,160
agency's control center these people are

193
00:07:08,950 --> 00:07:05,599
watching over this hardware watching

194
00:07:11,110 --> 00:07:08,960
over us 24 7 365. they're always there

195
00:07:13,430 --> 00:07:11,120
in fact a lot of what goes on in space

196
00:07:16,469 --> 00:07:13,440
station is conducted entirely remotely

197
00:07:18,070 --> 00:07:16,479
led by them but also remotely to all

198
00:07:18,950 --> 00:07:18,080
different places all around the world

199
00:07:20,790 --> 00:07:18,960
where

200
00:07:23,189 --> 00:07:20,800
science teams are running a lot of the

201
00:07:24,950 --> 00:07:23,199
experiments and there's nothing more

202
00:07:28,150 --> 00:07:24,960
comforting than having all those smart

203
00:07:28,950 --> 00:07:28,160
folks watching out for you all the time

204
00:07:31,670 --> 00:07:28,960
so

205
00:07:33,270 --> 00:07:31,680
we had we had a lot going for us as well

206
00:07:35,589 --> 00:07:33,280
when i look at overall our

207
00:07:37,430 --> 00:07:35,599
accomplishments i guess on the first

208
00:07:39,350 --> 00:07:37,440
count the crew is healthy and strong in

209
00:07:41,110 --> 00:07:39,360
fact i guess we're in some ways maybe in

210
00:07:43,110 --> 00:07:41,120
better shape in some respects than

211
00:07:45,270 --> 00:07:43,120
before we launched everybody's doing

212
00:07:46,950 --> 00:07:45,280
really well and everybody adapted

213
00:07:49,029 --> 00:07:46,960

phenomenally well to space flight and

214
00:07:50,309 --> 00:07:49,039
long duration space flight all of us

215
00:07:53,589 --> 00:07:50,319
love being here

216
00:07:55,990 --> 00:07:53,599
and uh again we're all great friends and

217
00:07:57,749 --> 00:07:56,000
um on the also on the uh the

218
00:07:59,749 --> 00:07:57,759
accomplishment side i would say the

219
00:08:01,990 --> 00:07:59,759
space station right now is in better

220
00:08:04,550 --> 00:08:02,000
shape than it's ever been uh during our

221
00:08:07,909 --> 00:08:04,560
time here we have done a major overhaul

222
00:08:09,830 --> 00:08:07,919
to the the space station's uh brains and

223
00:08:10,710 --> 00:08:09,840
nervous system if you will so there have

224
00:08:13,270 --> 00:08:10,720
been

225
00:08:15,909 --> 00:08:13,280
six major software upgrades that affect

226
00:08:17,749 --> 00:08:15,919
all the major computers and those

227
00:08:20,070 --> 00:08:17,759
involve command and control

228
00:08:22,629 --> 00:08:20,080
guidance and navigation they involve

229
00:08:24,869 --> 00:08:22,639
payloads and uh in a whole host of other

230
00:08:26,869 --> 00:08:24,879
systems in addition to the software

231
00:08:28,869 --> 00:08:26,879
upgrades there have been 23 major

232
00:08:30,950 --> 00:08:28,879
computer upgrades where we actually did

233
00:08:32,870 --> 00:08:30,960
brain surgery on these boxes pulled them

234
00:08:35,589 --> 00:08:32,880
out of the racks where they dwell and

235
00:08:37,750 --> 00:08:35,599
open them up and changed out the cards

236
00:08:40,630 --> 00:08:37,760
that were already in there with uh with

237
00:08:42,709 --> 00:08:40,640
faster more capable ones and we had a

238
00:08:45,269 --> 00:08:42,719

major software upgrade and in the

239
00:08:47,110 --> 00:08:45,279
service modules control software in the

240
00:08:49,269 --> 00:08:47,120
russian segment there was also a

241
00:08:51,910 --> 00:08:49,279
recently just last week or two weeks ago

242
00:08:53,829 --> 00:08:51,920
i guess now a major upgrade for the

243
00:08:55,110 --> 00:08:53,839
columbus the european space agency

244
00:08:56,550 --> 00:08:55,120
software

245
00:09:01,430 --> 00:08:56,560
so

246
00:09:04,070 --> 00:09:01,440
and brain surgery if you will

247
00:09:05,910 --> 00:09:04,080
there have been a lot of hardware a lot

248
00:09:07,350 --> 00:09:05,920
of hardware repairs and improvements

249
00:09:09,030 --> 00:09:07,360
that we've made and they

250
00:09:11,030 --> 00:09:09,040
run the gamut of almost every system we

251
00:09:12,790 --> 00:09:11,040
have up here

252
00:09:14,630 --> 00:09:12,800
part and parcel with the

253
00:09:17,350 --> 00:09:14,640
the upgrade for the com system and the

254
00:09:19,190 --> 00:09:17,360
computer system was laying new fiber

255
00:09:21,110 --> 00:09:19,200
optic and

256
00:09:23,990 --> 00:09:21,120
and high rate communication cables that

257
00:09:25,190 --> 00:09:24,000
will allow us to have high bandwidth

258
00:09:26,870 --> 00:09:25,200
payload

259
00:09:28,949 --> 00:09:26,880
data science data down the road that

260
00:09:30,710 --> 00:09:28,959
allow us to have more communications

261
00:09:32,870 --> 00:09:30,720
channels that'll basically

262
00:09:35,110 --> 00:09:32,880
increase greatly the throughput of

263
00:09:35,750 --> 00:09:35,120

science from space

264
00:09:36,949 --> 00:09:35,760
um station

265
00:09:39,430 --> 00:09:36,959
addition to that

266
00:09:42,550 --> 00:09:39,440
russian segment eva 30 the 30th eva

267
00:09:45,110 --> 00:09:42,560
conducted by uh by cosmonauts and u.s

268
00:09:47,590 --> 00:09:45,120
crew members when you look back on the

269
00:09:50,790 --> 00:09:47,600
russian segment was completed safely and

270
00:09:53,269 --> 00:09:50,800
successfully and it relocated oleg and

271
00:09:54,470 --> 00:09:53,279
anton relocated a very large crane

272
00:09:55,990 --> 00:09:54,480
construction crane that we have on the

273
00:09:57,430 --> 00:09:56,000
outside of station

274
00:10:00,230 --> 00:09:57,440
they installed a couple of payloads

275
00:10:04,230 --> 00:10:00,240
science payloads on the outside

276
00:10:06,949 --> 00:10:04,240
we in the japanese module demonstrated

277
00:10:09,190 --> 00:10:06,959
some very successful ground control

278
00:10:11,430 --> 00:10:09,200
ground remote operation tele operation

279
00:10:14,230 --> 00:10:11,440
if you will of the japanese experiment

280
00:10:15,829 --> 00:10:14,240
module remote manipulator system the arm

281
00:10:17,590 --> 00:10:15,839
that controls

282
00:10:19,269 --> 00:10:17,600
all of or that's able to access all of

283
00:10:20,949 --> 00:10:19,279
the payloads that are on the exposed

284
00:10:22,230 --> 00:10:20,959
facility on the forward port side of

285
00:10:24,310 --> 00:10:22,240
space station

286
00:10:26,870 --> 00:10:24,320
we had a lot of visiting vehicles we had

287
00:10:29,430 --> 00:10:26,880
when we got here the 45 progress

288
00:10:31,670 --> 00:10:29,440

progress number 45 was here we safely

289
00:10:34,230 --> 00:10:31,680
saw it on its way and

290
00:10:35,750 --> 00:10:34,240
it deployed a satellite a first for the

291
00:10:37,990 --> 00:10:35,760
for russian progress vehicles it

292
00:10:39,910 --> 00:10:38,000
deployed a satellite after leaving here

293
00:10:43,750 --> 00:10:39,920
one that we placed there

294
00:10:47,430 --> 00:10:43,760
we received progress 46p we recently

295
00:10:49,430 --> 00:10:47,440
we also received 29 soyuz with with don

296
00:10:51,269 --> 00:10:49,440
and oleg and andre

297
00:10:53,990 --> 00:10:51,279
and then we just a

298
00:10:56,310 --> 00:10:54,000
a couple of weeks ago received

299
00:10:58,710 --> 00:10:56,320
the atv the automated transfer vehicle

300
00:11:01,590 --> 00:10:58,720
number three a european space agency

301
00:11:03,269 --> 00:11:01,600
contribution so it's been a real busy

302
00:11:05,990 --> 00:11:03,279
time up here from the standpoint of

303
00:11:08,389 --> 00:11:06,000
visiting vehicle traffic

304
00:11:09,829 --> 00:11:08,399
what we did not see but we did help pave

305
00:11:13,350 --> 00:11:09,839
the way for was we didn't see the

306
00:11:15,110 --> 00:11:13,360
arrival yet of dragons the space

307
00:11:17,509 --> 00:11:15,120
exploration technology spacex

308
00:11:20,310 --> 00:11:17,519
corporation's dragon vehicle the first

309
00:11:22,310 --> 00:11:20,320
uh commercial provided uh cargo ship to

310
00:11:24,870 --> 00:11:22,320
space station uh what we did to pave the

311
00:11:27,030 --> 00:11:24,880
way for that though is we installed new

312
00:11:29,670 --> 00:11:27,040
software and in their

313
00:11:32,069 --> 00:11:29,680

communications unit the unit that that

314
00:11:34,310 --> 00:11:32,079
basically allows the transmission of

315
00:11:36,790 --> 00:11:34,320
telemetry and command between space

316
00:11:38,150 --> 00:11:36,800
station and the dragon and we upgraded

317
00:11:40,949 --> 00:11:38,160
the software in there and we actually

318
00:11:42,949 --> 00:11:40,959
took another box and uh and we have a

319
00:11:45,350 --> 00:11:42,959
backup and a primary now for that so we

320
00:11:47,030 --> 00:11:45,360
have redundancy in that respect and

321
00:11:48,550 --> 00:11:47,040
we've done a lot of other preparations

322
00:11:50,629 --> 00:11:48,560
to kind of pave the way for dragon which

323
00:11:52,629 --> 00:11:50,639
will be coming in a couple of weeks

324
00:11:54,790 --> 00:11:52,639
so on the visiting vehicle side very

325
00:11:59,190 --> 00:11:54,800
busy on the research side which was my

326
00:12:01,269 --> 00:11:59,200
third goal is we have done uh over 180

327
00:12:03,190 --> 00:12:01,279
separate scientific and technological

328
00:12:05,030 --> 00:12:03,200
investigations during our time here in

329
00:12:07,590 --> 00:12:05,040
station so it's been really busy and

330
00:12:09,430 --> 00:12:07,600
those run the gamut from human research

331
00:12:12,230 --> 00:12:09,440
which is one of the fundamental goals of

332
00:12:14,550 --> 00:12:12,240
the u.s segment science and that is how

333
00:12:16,470 --> 00:12:14,560
to figure out how humans adapt to space

334
00:12:18,470 --> 00:12:16,480
flight how to figure out how to make it

335
00:12:20,710 --> 00:12:18,480
safer so that we can ultimately leave

336
00:12:22,470 --> 00:12:20,720
low earth orbit go to the moon go to

337
00:12:24,710 --> 00:12:22,480
asteroids and go to mars and do that in

338
00:12:25,750 --> 00:12:24,720

a safe way a lot of changes happen and

339
00:12:27,430 --> 00:12:25,760
they change

340
00:12:30,550 --> 00:12:27,440
the changes occur in the physiology

341
00:12:32,710 --> 00:12:30,560
basic physiology musculoskeletal system

342
00:12:34,870 --> 00:12:32,720
the vascular system a lot of changes

343
00:12:37,509 --> 00:12:34,880
occur even in our perception our in our

344
00:12:38,870 --> 00:12:37,519
orientation systems our perception of of

345
00:12:40,870 --> 00:12:38,880
three-dimensional space and our

346
00:12:42,550 --> 00:12:40,880
orientation there all these things are

347
00:12:44,230 --> 00:12:42,560
really important things to know if we're

348
00:12:45,590 --> 00:12:44,240
going to get crews beyond low earth

349
00:12:47,590 --> 00:12:45,600
orbit which is one of the fundamental

350
00:12:48,949 --> 00:12:47,600
goals of space station

351
00:12:51,110 --> 00:12:48,959
in addition to that there's basic

352
00:12:53,509 --> 00:12:51,120
biological research we've done we have

353
00:12:55,110 --> 00:12:53,519
done fluid physics including a wonderful

354
00:12:56,550 --> 00:12:55,120
marangoni convection experiment

355
00:12:57,430 --> 00:12:56,560
experiment that was conducted in the

356
00:12:59,670 --> 00:12:57,440
kibo

357
00:13:01,670 --> 00:12:59,680
japanese experiment module

358
00:13:03,350 --> 00:13:01,680
capillary flow experiments combustion

359
00:13:06,629 --> 00:13:03,360
experiments including an experiment

360
00:13:09,269 --> 00:13:06,639
called spice or as we call it splice and

361
00:13:12,550 --> 00:13:09,279
and also recently a combustion of solids

362
00:13:13,750 --> 00:13:12,560
in space experiments called bass

363
00:13:15,590 --> 00:13:13,760

we have

364
00:13:17,670 --> 00:13:15,600
conducted a lot of

365
00:13:19,829 --> 00:13:17,680
earth science here from space station we

366
00:13:23,269 --> 00:13:19,839
have managed at least the crew handheld

367
00:13:26,389 --> 00:13:23,279
imagery uh to take uh upwards of 200 000

368
00:13:27,430 --> 00:13:26,399
images of planet earth from here and in

369
00:13:29,269 --> 00:13:27,440
addition to that there are a lot of

370
00:13:31,590 --> 00:13:29,279
remote sensors around

371
00:13:33,670 --> 00:13:31,600
the space station that both image earth

372
00:13:34,629 --> 00:13:33,680
and image deep space

373
00:13:36,389 --> 00:13:34,639
and

374
00:13:38,230 --> 00:13:36,399
on the technological

375
00:13:41,110 --> 00:13:38,240
experiment side of the technological

376
00:13:43,590 --> 00:13:41,120
development side i think space station

377
00:13:44,949 --> 00:13:43,600
because of its location on a frontier

378
00:13:46,710 --> 00:13:44,959
and probably one of the harshest

379
00:13:49,509 --> 00:13:46,720
environments known to man

380
00:13:51,910 --> 00:13:49,519
is in and of itself a global a very

381
00:13:52,949 --> 00:13:51,920
large technological research

382
00:13:54,870 --> 00:13:52,959
project

383
00:13:57,829 --> 00:13:54,880
figuring out how to keep hardware

384
00:13:59,430 --> 00:13:57,839
operating long term here is absolutely

385
00:14:01,430 --> 00:13:59,440
crucial it's crucial if we're ever going

386
00:14:02,949 --> 00:14:01,440
to leave low earth orbit we have to be

387
00:14:06,310 --> 00:14:02,959
able to safely

388
00:14:07,990 --> 00:14:06,320

sever the fairly regular logistic stream

389
00:14:09,910 --> 00:14:08,000
the lifeblood that we have that allows

390
00:14:10,629 --> 00:14:09,920
us to get spare parts that allows us to

391
00:14:13,030 --> 00:14:10,639
get

392
00:14:15,030 --> 00:14:13,040
consumables from planet earth here we

393
00:14:17,269 --> 00:14:15,040
have to figure out a way how to have

394
00:14:19,590 --> 00:14:17,279
crews be able to do all kinds of

395
00:14:21,189 --> 00:14:19,600
intricate repairs on space station all

396
00:14:23,750 --> 00:14:21,199
the vehicles the us has ever flown

397
00:14:25,750 --> 00:14:23,760
before have always been returned to the

398
00:14:27,829 --> 00:14:25,760
professionals or been returned to

399
00:14:30,310 --> 00:14:27,839
museums right after space flight crews

400
00:14:32,069 --> 00:14:30,320
have never had to turn wrenches to the

401
00:14:33,750 --> 00:14:32,079
degree that we have to onboard space

402
00:14:35,189 --> 00:14:33,760
station right now

403
00:14:37,030 --> 00:14:35,199
on the space shuttle if there was a

404
00:14:39,110 --> 00:14:37,040
problem you would basically get the

405
00:14:40,710 --> 00:14:39,120
system in a safe enough configuration so

406
00:14:42,710 --> 00:14:40,720
that the shuttle when it returned to the

407
00:14:44,310 --> 00:14:42,720
kennedy space center and was placed in

408
00:14:47,189 --> 00:14:44,320
the hands of the brilliant technicians

409
00:14:50,550 --> 00:14:47,199
and engineers there could be rebuilt and

410
00:14:52,389 --> 00:14:50,560
and and be just as good as new and we

411
00:14:54,470 --> 00:14:52,399
basically need to be able to do similar

412
00:14:57,590 --> 00:14:54,480
level repairs here on space station it's

413
00:14:59,430 --> 00:14:57,600

a whole new uh way of operating for for

414
00:15:01,509 --> 00:14:59,440
astronauts and for the ground crews that

415
00:15:03,269 --> 00:15:01,519
plan how we do things so on the global

416
00:15:05,110 --> 00:15:03,279
scale this is a really important thing

417
00:15:06,710 --> 00:15:05,120
and and i think we've had a chance to

418
00:15:09,189 --> 00:15:06,720
turn a lot of wrenches and do a lot of

419
00:15:10,710 --> 00:15:09,199
work along those lines

420
00:15:13,110 --> 00:15:10,720
there's also a couple of other smaller

421
00:15:14,790 --> 00:15:13,120
experiments here that i think are

422
00:15:17,430 --> 00:15:14,800
important along those same lines for

423
00:15:19,269 --> 00:15:17,440
technological research and one is

424
00:15:21,189 --> 00:15:19,279
robonaut which is

425
00:15:23,990 --> 00:15:21,199
basically a human-like from an

426
00:15:26,949 --> 00:15:24,000
anthropometric standpoint robot that is

427
00:15:29,990 --> 00:15:26,959
a technology testbed to figure out how

428
00:15:32,310 --> 00:15:30,000
we can incorporate robotics here in

429
00:15:33,990 --> 00:15:32,320
space to reduce the risk

430
00:15:36,310 --> 00:15:34,000
to maybe

431
00:15:38,470 --> 00:15:36,320
maybe capitalize on the crew time a

432
00:15:41,269 --> 00:15:38,480
little bit more by giving more mundane

433
00:15:43,189 --> 00:15:41,279
and routine kinds of tasks to robotics

434
00:15:45,269 --> 00:15:43,199
but also potentially

435
00:15:47,430 --> 00:15:45,279
down the road we'd like to think to be

436
00:15:50,550 --> 00:15:47,440
able to take robots like that outside

437
00:15:52,389 --> 00:15:50,560
with us during spacewalks and by having

438
00:15:54,790 --> 00:15:52,399

hands that are just like human hands

439
00:15:56,710 --> 00:15:54,800
they that robonaut can you know in

440
00:16:00,470 --> 00:15:56,720
effect operate with all the tools that

441
00:16:02,710 --> 00:16:00,480
we operate and so it is a very a very

442
00:16:05,430 --> 00:16:02,720
clever very intricate very complicated

443
00:16:06,389 --> 00:16:05,440
but very promising kind of technological

444
00:16:07,990 --> 00:16:06,399
research

445
00:16:09,990 --> 00:16:08,000
it's a we actually put him to work last

446
00:16:11,670 --> 00:16:10,000
month and he was uh taking uh

447
00:16:13,350 --> 00:16:11,680
readings on uh

448
00:16:16,790 --> 00:16:13,360
an instrument called the velocicalcan

449
00:16:19,509 --> 00:16:16,800
basically reading uh the uh the velocity

450
00:16:22,389 --> 00:16:19,519
out of um uh inner module ventilation

451
00:16:24,069 --> 00:16:22,399
ducts and uh and it was a

452
00:16:25,430 --> 00:16:24,079
very neat thing to see

453
00:16:28,150 --> 00:16:25,440
probably one of the most important

454
00:16:30,790 --> 00:16:28,160
technological research um things that we

455
00:16:32,790 --> 00:16:30,800
have going on board space station is uh

456
00:16:34,870 --> 00:16:32,800
the regenerative environmental control

457
00:16:37,590 --> 00:16:34,880
life support system so the racks that

458
00:16:39,030 --> 00:16:37,600
make up uh the uh

459
00:16:39,829 --> 00:16:39,040
the uh

460
00:16:41,829 --> 00:16:39,839
the

461
00:16:43,829 --> 00:16:41,839
capability for us to

462
00:16:45,749 --> 00:16:43,839
to close the life support loop or at

463
00:16:48,150 --> 00:16:45,759

least partially close that are critical

464
00:16:49,990 --> 00:16:48,160
critical for exploring deep space every

465
00:16:51,990 --> 00:16:50,000
pound of stuff that we bring to space

466
00:16:55,670 --> 00:16:52,000
right now to low earth orbit takes 20 to

467
00:16:57,030 --> 00:16:55,680
25 pounds of rocket fuel and rocket body

468
00:16:58,550 --> 00:16:57,040
to get it up here that's how much

469
00:17:00,870 --> 00:16:58,560
kinetic energy you have to put into it

470
00:17:03,269 --> 00:17:00,880
to get here it means that every pound of

471
00:17:05,350 --> 00:17:03,279
me every pound of air that i breathe the

472
00:17:07,429 --> 00:17:05,360
food that i eat every pound of of

473
00:17:10,390 --> 00:17:07,439
scientific experiment payload that we

474
00:17:13,510 --> 00:17:10,400
install and work on in a rack here takes

475
00:17:15,669 --> 00:17:13,520
20 fold times more in rocket fuel to get

476
00:17:17,110 --> 00:17:15,679
here so what we want to do is basically

477
00:17:20,150 --> 00:17:17,120
capture all

478
00:17:22,069 --> 00:17:20,160
the moisture that we exhale all the

479
00:17:24,309 --> 00:17:22,079
moisture through urination that we we

480
00:17:26,949 --> 00:17:24,319
get rid of and take that and purify that

481
00:17:29,029 --> 00:17:26,959
water and uh and feed that water back

482
00:17:30,950 --> 00:17:29,039
into the front end of the environmental

483
00:17:32,870 --> 00:17:30,960
control system loop so it doesn't cost

484
00:17:35,270 --> 00:17:32,880
all that that much money and that

485
00:17:37,750 --> 00:17:35,280
technology also is very promising uh

486
00:17:40,710 --> 00:17:37,760
down the road for for allowing you to uh

487
00:17:42,549 --> 00:17:40,720
to deal with disasters in

488
00:17:44,390 --> 00:17:42,559

in areas where suddenly you don't have

489
00:17:46,950 --> 00:17:44,400
water available allows you to purify

490
00:17:49,270 --> 00:17:46,960
water and uh and do it in a in a very

491
00:17:50,070 --> 00:17:49,280
cost effective way

492
00:17:50,789 --> 00:17:50,080
so

493
00:17:53,190 --> 00:17:50,799
the

494
00:17:55,350 --> 00:17:53,200
that that whole piece of space station

495
00:17:57,029 --> 00:17:55,360
doesn't fall under the the rubric of

496
00:17:58,870 --> 00:17:57,039
what we call science investigation but

497
00:18:01,270 --> 00:17:58,880
it's a very important technological

498
00:18:02,870 --> 00:18:01,280
research investigation and we have spent

499
00:18:04,390 --> 00:18:02,880
a lot of time in those racks and spent a

500
00:18:06,950 --> 00:18:04,400
lot of time keeping that equipment

501
00:18:10,070 --> 00:18:06,960
working and in so doing have learned a

502
00:18:11,669 --> 00:18:10,080
lot about how uh how that gear works how

503
00:18:13,110 --> 00:18:11,679
to make it better for applications on

504
00:18:16,070 --> 00:18:13,120
earth how to make it better for

505
00:18:18,470 --> 00:18:16,080
applications leaving low earth or orbit

506
00:18:20,390 --> 00:18:18,480
so all in all when i look back on

507
00:18:21,270 --> 00:18:20,400
my tenure here and

508
00:18:23,510 --> 00:18:21,280
and

509
00:18:25,029 --> 00:18:23,520
thinking about returning home

510
00:18:26,870 --> 00:18:25,039
i think all of us can feel really good

511
00:18:30,549 --> 00:18:26,880
about the amount of things we got done

512
00:18:33,029 --> 00:18:30,559
and again i cannot overemphasize

513
00:18:34,630 --> 00:18:33,039

how much and how critical it is all the

514
00:18:36,870 --> 00:18:34,640
people that work on the ground that make

515
00:18:39,510 --> 00:18:36,880
all this possible and we're just one

516
00:18:41,190 --> 00:18:39,520
small part of that equation

517
00:18:42,390 --> 00:18:41,200
now when i sit down and think for a

518
00:18:44,870 --> 00:18:42,400
moment about

519
00:18:47,750 --> 00:18:44,880
about returning to planet earth

520
00:18:50,070 --> 00:18:47,760
part of me is really going to miss this

521
00:18:52,230 --> 00:18:50,080
it's indescribably wonderful to live in

522
00:18:54,150 --> 00:18:52,240
space to to have the incredible

523
00:18:55,510 --> 00:18:54,160
privilege of being up here to do the

524
00:18:57,029 --> 00:18:55,520
research we do

525
00:18:58,789 --> 00:18:57,039
to just float around to look out the

526
00:19:00,710 --> 00:18:58,799
window and see planet earth below and

527
00:19:01,990 --> 00:19:00,720
the and the stars

528
00:19:03,430 --> 00:19:02,000
above us

529
00:19:05,190 --> 00:19:03,440
and

530
00:19:07,190 --> 00:19:05,200
but by the same token

531
00:19:09,430 --> 00:19:07,200
it'll be so wonderful to see family

532
00:19:10,870 --> 00:19:09,440
again you you get to see your family

533
00:19:12,710 --> 00:19:10,880
once a week you get to talk to them on

534
00:19:14,630 --> 00:19:12,720
the phone every time you get uh some you

535
00:19:16,870 --> 00:19:14,640
know a chance maybe a once or twice a

536
00:19:18,150 --> 00:19:16,880
day even but it's not the same as being

537
00:19:20,070 --> 00:19:18,160
there so

538
00:19:21,830 --> 00:19:20,080

leaving this place will be hard seeing

539
00:19:23,350 --> 00:19:21,840
my family again will be the most

540
00:19:25,190 --> 00:19:23,360
wonderful consolation prize you can

541
00:19:27,029 --> 00:19:25,200
imagine

542
00:19:29,669 --> 00:19:27,039
smelling

543
00:19:31,669 --> 00:19:29,679
the the aromas of planet earth

544
00:19:33,510 --> 00:19:31,679
landing in the kazakh step

545
00:19:35,430 --> 00:19:33,520
on our soyuz and

546
00:19:36,549 --> 00:19:35,440
and uh and just climbing out of the

547
00:19:38,470 --> 00:19:36,559
hatch and

548
00:19:40,470 --> 00:19:38,480
and feeling fresh air on our face will

549
00:19:41,830 --> 00:19:40,480
be uh will be wonderful

550
00:19:43,750 --> 00:19:41,840
um

551
00:19:45,669 --> 00:19:43,760
the food that we have up here is great

552
00:19:46,950 --> 00:19:45,679
um there's a lot of uh

553
00:19:48,630 --> 00:19:46,960
of uh

554
00:19:50,310 --> 00:19:48,640
food that uh

555
00:19:51,830 --> 00:19:50,320
that i would that i can't have up here

556
00:19:55,110 --> 00:19:51,840
that i would very much like to have that

557
00:19:57,430 --> 00:19:55,120
will also be a good consolation prize

558
00:19:58,870 --> 00:19:57,440
the ride itself going uh leaving space

559
00:20:01,590 --> 00:19:58,880
station rendering earth earth's

560
00:20:03,750 --> 00:20:01,600
atmosphere in a capsule will be uh will

561
00:20:05,190 --> 00:20:03,760
be pretty spectacular by all accounts

562
00:20:06,549 --> 00:20:05,200
having done it a couple of times in a

563
00:20:08,630 --> 00:20:06,559

shuttle

564
00:20:09,750 --> 00:20:08,640
i really look forward to the experience

565
00:20:17,270 --> 00:20:09,760
to

566
00:20:19,270 --> 00:20:17,280
a little bit sharper deceleration

567
00:20:20,950 --> 00:20:19,280
particularly at the very bottom

568
00:20:23,270 --> 00:20:20,960
but i think it'll be an awful lot of fun

569
00:20:26,070 --> 00:20:23,280
if the ride uphill was any indication

570
00:20:27,830 --> 00:20:26,080
it'll be a tremendous amount of fun and