
NASA AT HOME
SPACEPORT SERIES

1
00:00:16,810 --> 00:00:37,430
[Music]

2
00:00:40,150 --> 00:00:38,069
welcome back

3
00:00:42,229 --> 00:00:40,160
i'm joshua santora coming to you from

4
00:00:43,910 --> 00:00:42,239
near the kennedy space center

5
00:00:45,670 --> 00:00:43,920
today we're going to wrap up our series

6
00:00:47,670 --> 00:00:45,680
focused on looking at

7
00:00:49,110 --> 00:00:47,680
the the challenge of getting humans in a

8
00:00:50,790 --> 00:00:49,120
deep space and what's involved

9
00:00:52,229 --> 00:00:50,800
and how the world's premier spaceport

10
00:00:54,310 --> 00:00:52,239
the kennedy space center

11
00:00:55,830 --> 00:00:54,320
is so actively involved in so much of

12
00:00:57,510 --> 00:00:55,840
that process

13
00:00:59,349 --> 00:00:57,520

so far we've looked at the commercial

14
00:01:00,389 --> 00:00:59,359
crew program and science in low-earth

15
00:01:02,389 --> 00:01:00,399
orbit

16
00:01:04,710 --> 00:01:02,399
we looked at plotting the course to deep

17
00:01:06,390 --> 00:01:04,720
space and how robotic pre-cursor

18
00:01:08,230 --> 00:01:06,400
missions are helping us explore

19
00:01:09,429 --> 00:01:08,240
specifically mars 2020 and the

20
00:01:13,030 --> 00:01:09,439
perseverance of rover

21
00:01:16,070 --> 00:01:13,040
which is set to land on mars on february

22
00:01:17,830 --> 00:01:16,080
18 2021

23
00:01:19,830 --> 00:01:17,840
then we took a look at gateway and how

24
00:01:20,550 --> 00:01:19,840
commercial partnerships are helping us

25
00:01:22,950 --> 00:01:20,560
get further

26
00:01:25,109 --> 00:01:22,960
faster and then last time we wrapped up

27
00:01:26,310 --> 00:01:25,119
with the space launch system and what it

28
00:01:29,190 --> 00:01:26,320
takes to launch

29
00:01:31,190 --> 00:01:29,200
the world's most powerful rocket today

30
00:01:35,190 --> 00:01:31,200
we're just going to skim the surface of

31
00:01:37,429 --> 00:01:35,200
in-situ resource utilization or isru

32
00:01:39,190 --> 00:01:37,439
which is really a fancy term for living

33
00:01:40,469 --> 00:01:39,200
off of the land

34
00:01:42,389 --> 00:01:40,479
before we get to our interview with a

35
00:01:43,030 --> 00:01:42,399
couple scientists who are focused on a

36
00:01:45,270 --> 00:01:43,040
project

37
00:01:46,950 --> 00:01:45,280
that deals with deep space recycling

38
00:01:48,149 --> 00:01:46,960

here's a word from one of our engineers

39
00:01:50,469 --> 00:01:48,159
elspet peterson

40
00:01:51,830 --> 00:01:50,479
to explain more about isru and why it's

41
00:01:55,270 --> 00:01:51,840
so important

42
00:01:57,590 --> 00:01:55,280
so in situ resource utilization or isru

43
00:01:58,389 --> 00:01:57,600
means using resources that aren't from

44
00:02:01,109 --> 00:01:58,399
earth

45
00:02:01,990 --> 00:02:01,119
in order to carry out different missions

46
00:02:04,709 --> 00:02:02,000
and so

47
00:02:06,069 --> 00:02:04,719
um isru is important for a number of

48
00:02:07,670 --> 00:02:06,079
different reasons

49
00:02:09,510 --> 00:02:07,680
one of the ones that we think about most

50
00:02:11,990 --> 00:02:09,520
is cost and so

51
00:02:12,710 --> 00:02:12,000
when you think about taking a pound of

52
00:02:14,869 --> 00:02:12,720
for example

53
00:02:16,390 --> 00:02:14,879
oxygen or other things that astronauts

54
00:02:18,390 --> 00:02:16,400
might need um

55
00:02:19,910 --> 00:02:18,400
off of the earth that's going to cost

56
00:02:21,270 --> 00:02:19,920
thousands of dollars and so if we can

57
00:02:22,630 --> 00:02:21,280
produce those resources where they're

58
00:02:25,830 --> 00:02:22,640
going to be needed such as

59
00:02:27,430 --> 00:02:25,840
on the moon or on mars then those are

60
00:02:28,070 --> 00:02:27,440
pounds that we don't have to launch from

61
00:02:29,990 --> 00:02:28,080
earth

62
00:02:31,910 --> 00:02:30,000
saving us money another thing that's

63
00:02:33,350 --> 00:02:31,920

really important about isru

64
00:02:35,430 --> 00:02:33,360
is to have that resource available

65
00:02:36,710 --> 00:02:35,440
locally and so right now we've got

66
00:02:38,229 --> 00:02:36,720
astronauts that have been living around

67
00:02:41,509 --> 00:02:38,239
the earth in lower earth orbit

68
00:02:43,190 --> 00:02:41,519
for 20 years and we i

69
00:02:44,550 --> 00:02:43,200
often have resupply missions that you

70
00:02:46,150 --> 00:02:44,560
know take a day to get it there

71
00:02:48,150 --> 00:02:46,160
um when we talk about the artemis

72
00:02:49,830 --> 00:02:48,160
project then they're on the moon and

73
00:02:50,790 --> 00:02:49,840
it's going to take much longer days to

74
00:02:52,949 --> 00:02:50,800
weeks to get

75
00:02:54,630 --> 00:02:52,959
resupply missions and so being able to

76
00:02:55,270 --> 00:02:54,640
produce resources where they're going to

77
00:02:58,470 --> 00:02:55,280
be needed

78
00:03:00,470 --> 00:02:58,480
is extremely important oxygen extraction

79
00:03:01,670 --> 00:03:00,480
are two two projects that i'm working on

80
00:03:02,869 --> 00:03:01,680
here at kennedy

81
00:03:05,110 --> 00:03:02,879
one is called molten regolith

82
00:03:07,830 --> 00:03:05,120
electrolysis where we actually melt

83
00:03:09,509 --> 00:03:07,840
the rocks on the moon in order to get

84
00:03:11,350 --> 00:03:09,519
the oxygen out of them and the other one

85
00:03:12,869 --> 00:03:11,360
uses a hydrogen plasma

86
00:03:14,550 --> 00:03:12,879
so i'm obviously really excited about

87
00:03:15,430 --> 00:03:14,560
those projects getting oxygen on the

88
00:03:17,589 --> 00:03:15,440

moon

89
00:03:19,509 --> 00:03:17,599
for people but also for propellant these

90
00:03:20,710 --> 00:03:19,519
kinds of isru plants that we're

91
00:03:23,750 --> 00:03:20,720
envisioning for the moon are going to

92
00:03:25,670 --> 00:03:23,760
create tons of oxygen per year

93
00:03:27,430 --> 00:03:25,680
and so when you think about things at

94
00:03:28,710 --> 00:03:27,440
that scale obviously it becomes much

95
00:03:29,990 --> 00:03:28,720
more important to be able to create it

96
00:03:31,430 --> 00:03:30,000
locally

97
00:03:33,750 --> 00:03:31,440
and then last something that a lot of

98
00:03:36,149 --> 00:03:33,760
people don't think about is construction

99
00:03:37,509 --> 00:03:36,159
and so building habitats for people um

100
00:03:39,830 --> 00:03:37,519
here on earth we use

101
00:03:41,589 --> 00:03:39,840
wood and cement that's obviously going

102
00:03:42,789 --> 00:03:41,599
to be cost prohibitive to take with us

103
00:03:44,550 --> 00:03:42,799
so we can use the rocks that are

104
00:03:47,030 --> 00:03:44,560
available on the moon and you need

105
00:03:49,110 --> 00:03:47,040
specialized equipment to enable to

106
00:03:50,710 --> 00:03:49,120
dig the rocks up and handle it because

107
00:03:53,750 --> 00:03:50,720
the dust is very sharp

108
00:03:55,750 --> 00:03:53,760
it's also very staticky and so um and

109
00:03:59,110 --> 00:03:55,760
it's very cold on the moon and so

110
00:04:03,429 --> 00:04:01,270
deal with those kinds of situations is

111
00:04:05,429 --> 00:04:03,439
is going to take a really specialized

112
00:04:07,110 --> 00:04:05,439
group of robots in order to carry out

113
00:04:08,710 --> 00:04:07,120

that kind of construction work

114
00:04:10,550 --> 00:04:08,720
and so that's just a few projects going

115
00:04:11,990 --> 00:04:10,560
on here at kennedy space center

116
00:04:13,750 --> 00:04:12,000
obviously a lot of resources are going

117
00:04:15,110 --> 00:04:13,760
to be needed if we're sending humans out

118
00:04:16,789 --> 00:04:15,120
into the solar system

119
00:04:18,710 --> 00:04:16,799
and so there's a lot of isru projects

120
00:04:20,310 --> 00:04:18,720
going on across the agency

121
00:04:23,189 --> 00:04:20,320
and so we're just really excited to be

122
00:04:25,270 --> 00:04:23,199
part of human exploration

123
00:04:26,790 --> 00:04:25,280
and the next man and first woman that

124
00:04:30,070 --> 00:04:26,800
are going to set foot on the moon

125
00:04:33,830 --> 00:04:31,830
it is so exciting to think about in just

126
00:04:34,629 --> 00:04:33,840
a few short years being able to look up

127
00:04:36,150 --> 00:04:34,639
at the moon

128
00:04:38,230 --> 00:04:36,160
and know that we have humans that are

129
00:04:40,150 --> 00:04:38,240
there exploring and establishing a

130
00:04:41,590 --> 00:04:40,160
sustained presence

131
00:04:43,110 --> 00:04:41,600
elsbeth mentioned a couple different

132
00:04:43,830 --> 00:04:43,120
projects at work here at the kennedy

133
00:04:44,790 --> 00:04:43,840
space center

134
00:04:47,189 --> 00:04:44,800
and we're going to look at one in

135
00:04:48,230 --> 00:04:47,199
particular now the organic processor

136
00:04:51,510 --> 00:04:48,240
assembly or

137
00:04:53,189 --> 00:04:51,520
opa joining us are nasa's dr

138
00:04:54,710 --> 00:04:53,199

luke roberson who is the principal

139
00:04:56,950 --> 00:04:54,720
investigator for opa

140
00:04:58,390 --> 00:04:56,960
and dr daniel yay professor of

141
00:05:00,790 --> 00:04:58,400
environmental engineering

142
00:05:03,510 --> 00:05:00,800
at the university of south florida

143
00:05:06,870 --> 00:05:03,520
gentlemen thank you for joining me

144
00:05:08,550 --> 00:05:06,880
hi josh great to be here let's jump

145
00:05:11,029 --> 00:05:08,560
right in uh luke can you give us kind of

146
00:05:12,790 --> 00:05:11,039
a high level picture of what opa is so

147
00:05:14,629 --> 00:05:12,800
the opa is our first stage

148
00:05:15,670 --> 00:05:14,639
of our wastewater treatment facility

149
00:05:16,629 --> 00:05:15,680
that we're planning to build for the

150
00:05:19,670 --> 00:05:16,639
moon

151
00:05:21,670 --> 00:05:19,680
so as we go from low earth orbit and

152
00:05:22,390 --> 00:05:21,680
space travel to long duration space

153
00:05:24,469 --> 00:05:22,400
missions

154
00:05:25,749 --> 00:05:24,479
we're going to need a way to be able to

155
00:05:31,350 --> 00:05:25,759
trans

156
00:05:33,430 --> 00:05:31,360
all of the waste water and be able to

157
00:05:35,749 --> 00:05:33,440
regenerate that for

158
00:05:38,390 --> 00:05:35,759
pure weight pure water for our science

159
00:05:40,070 --> 00:05:38,400
needs for human consumption

160
00:05:41,510 --> 00:05:40,080
daniel i know we do some of this already

161
00:05:43,350 --> 00:05:41,520
now on the space station

162
00:05:44,550 --> 00:05:43,360
so is this really just a matter of

163
00:05:46,390 --> 00:05:44,560

turning that application

164
00:05:48,150 --> 00:05:46,400
into a use for deep space or is there

165
00:05:50,310 --> 00:05:48,160
more to it

166
00:05:51,189 --> 00:05:50,320
well right now on the international

167
00:05:53,110 --> 00:05:51,199
space station

168
00:05:55,270 --> 00:05:53,120
you know nasa is doing a phenomenal job

169
00:05:57,430 --> 00:05:55,280
at recycling the water that's on there

170
00:05:58,870 --> 00:05:57,440
so what we're aiming to do is to go to

171
00:06:00,950 --> 00:05:58,880
the next generation of

172
00:06:02,950 --> 00:06:00,960
water recycling in fact we're going to

173
00:06:06,390 --> 00:06:02,960
go beyond water recycling

174
00:06:08,070 --> 00:06:06,400
and try to recycle all the elements uh

175
00:06:09,830 --> 00:06:08,080
you know currently vehicle material

176
00:06:12,150 --> 00:06:09,840
isn't being recycled

177
00:06:14,309 --> 00:06:12,160
and neither is food waste and within

178
00:06:16,390 --> 00:06:14,319
them there's valuable nutrients that we

179
00:06:18,790 --> 00:06:16,400
could recover to grow food

180
00:06:20,070 --> 00:06:18,800
so like luke mentioned earlier as we

181
00:06:22,710 --> 00:06:20,080
move further away from

182
00:06:23,189 --> 00:06:22,720
lower earth orbit and eventually to mars

183
00:06:25,909 --> 00:06:23,199
uh

184
00:06:27,110 --> 00:06:25,919
the ability to provide a renewable

185
00:06:28,710 --> 00:06:27,120
source of fertilizer is going to be

186
00:06:30,309 --> 00:06:28,720
really important

187
00:06:32,150 --> 00:06:30,319
so you're talking about something that

188
00:06:34,710 --> 00:06:32,160

sounds really sustainable from

189
00:06:36,790 --> 00:06:34,720
the human to the ground to the plant and

190
00:06:38,469 --> 00:06:36,800
back to the human again

191
00:06:40,790 --> 00:06:38,479
this is this is nothing human

192
00:06:42,230 --> 00:06:40,800
civilization has not been doing for you

193
00:06:44,469 --> 00:06:42,240
know tens of thousands of years

194
00:06:46,230 --> 00:06:44,479
but we're just uh trying to do this

195
00:06:47,510 --> 00:06:46,240
offline

196
00:06:49,270 --> 00:06:47,520
i think there's a lot of people that

197
00:06:51,670 --> 00:06:49,280
would be surprised if they could

198
00:06:52,950 --> 00:06:51,680
understand the breadth and depth of the

199
00:06:55,510 --> 00:06:52,960
collaborations that exist

200
00:06:57,510 --> 00:06:55,520
even today between nasa and academia and

201
00:06:59,110 --> 00:06:57,520
how mutually beneficial it is

202
00:07:00,870 --> 00:06:59,120
can you kind of summarize the value in

203
00:07:02,870 --> 00:07:00,880
working together

204
00:07:04,150 --> 00:07:02,880
so as far as collaborations go the

205
00:07:05,350 --> 00:07:04,160
diversity of thought is the most

206
00:07:06,710 --> 00:07:05,360
important thing when you bring in a

207
00:07:09,909 --> 00:07:06,720
different perspective

208
00:07:12,390 --> 00:07:09,919
from a different skill set to the team

209
00:07:13,830 --> 00:07:12,400
it builds the team and makes it stronger

210
00:07:15,110 --> 00:07:13,840
so teaming up with daniel and the

211
00:07:17,029 --> 00:07:15,120
university of south florida with his

212
00:07:19,029 --> 00:07:17,039
environmental engineering background

213
00:07:20,790 --> 00:07:19,039

complements the chemistry and biology

214
00:07:22,550 --> 00:07:20,800
backgrounds that we have within the

215
00:07:24,309 --> 00:07:22,560
agency

216
00:07:25,990 --> 00:07:24,319
daniel as we mentioned you're obviously

217
00:07:28,230 --> 00:07:26,000
a professor and so i would hope that

218
00:07:29,909 --> 00:07:28,240
you're engaging students in this process

219
00:07:31,749 --> 00:07:29,919
can you talk about some of the benefits

220
00:07:35,430 --> 00:07:31,759
for getting students involved

221
00:07:37,270 --> 00:07:35,440
in real world or outer world projects

222
00:07:38,790 --> 00:07:37,280
yeah we have a team of students uh who

223
00:07:41,189 --> 00:07:38,800
are involved with this project

224
00:07:43,350 --> 00:07:41,199
uh some of some of them only on the usf

225
00:07:46,150 --> 00:07:43,360
side and some of them are more active

226
00:07:49,029 --> 00:07:46,160
going back and forth uh one example is a

227
00:07:50,950 --> 00:07:49,039
phd student named talent bullard

228
00:07:52,230 --> 00:07:50,960
and for him you know i mean he's dreamed

229
00:07:54,629 --> 00:07:52,240
of working at nasa

230
00:07:55,909 --> 00:07:54,639
working for nasa since he was a kid but

231
00:07:57,909 --> 00:07:55,919
more importantly i think he's

232
00:07:59,990 --> 00:07:57,919
getting some really important hands-on

233
00:08:01,589 --> 00:08:00,000
training uh learning about how people in

234
00:08:03,510 --> 00:08:01,599
nasa think about

235
00:08:05,670 --> 00:08:03,520
uh you know all the requirements to to

236
00:08:08,150 --> 00:08:05,680
make to mission critical

237
00:08:09,749 --> 00:08:08,160
it is one thing to talk about recycling

238
00:08:11,589 --> 00:08:09,759

it's a whole nother thing to be able to

239
00:08:14,390 --> 00:08:11,599
recycle efficiently and effectively

240
00:08:17,350 --> 00:08:14,400
just here on earth it's mind-blowing to

241
00:08:18,710 --> 00:08:17,360
think about recycling in deep space

242
00:08:19,990 --> 00:08:18,720
and i'm sure it's challenging can you

243
00:08:21,670 --> 00:08:20,000
talk about some of the challenges in

244
00:08:24,230 --> 00:08:21,680
making opa a reality

245
00:08:25,510 --> 00:08:24,240
so the biggest challenge is balancing

246
00:08:27,029 --> 00:08:25,520
each and one of the element cycles that

247
00:08:30,390 --> 00:08:27,039
daniel is talking about

248
00:08:32,550 --> 00:08:30,400
so each element has its own composition

249
00:08:35,350 --> 00:08:32,560
and those compositions have to be broken

250
00:08:36,149 --> 00:08:35,360
down from the human urine from the human

251
00:08:38,870 --> 00:08:36,159
fecal matter

252
00:08:39,509 --> 00:08:38,880
from humidity condensate to laundry

253
00:08:41,190 --> 00:08:39,519
water

254
00:08:42,630 --> 00:08:41,200
and each of those different chemistries

255
00:08:45,509 --> 00:08:42,640
that come into

256
00:08:46,070 --> 00:08:45,519
our reactors have to be broken down and

257
00:08:49,910 --> 00:08:46,080
then

258
00:08:53,030 --> 00:08:49,920
isolated or suspended or collected or

259
00:08:58,710 --> 00:08:54,710
done something with to be able to

260
00:09:03,350 --> 00:09:01,430
yeah and and to me a lot of this has to

261
00:09:05,590 --> 00:09:03,360
do with miniaturization

262
00:09:07,350 --> 00:09:05,600
you know we don't have the luxury of

263
00:09:10,949 --> 00:09:07,360

having a lot of volume and

264
00:09:12,870 --> 00:09:10,959
mass that were afforded on earth

265
00:09:13,990 --> 00:09:12,880
and also there's very room very little

266
00:09:15,829 --> 00:09:14,000
room for error

267
00:09:18,389 --> 00:09:15,839
so we have to make something that's very

268
00:09:20,550 --> 00:09:18,399
compact and highly reliable

269
00:09:22,230 --> 00:09:20,560
and it's going to require iterations

270
00:09:24,150 --> 00:09:22,240
after iterations

271
00:09:26,150 --> 00:09:24,160
in the same way that you know we then

272
00:09:28,310 --> 00:09:26,160
land on the moon in one try

273
00:09:29,350 --> 00:09:28,320
it took a lot of iterations and it's

274
00:09:30,790 --> 00:09:29,360
going to require that

275
00:09:33,269 --> 00:09:30,800
but fortunately we're not starting from

276
00:09:35,030 --> 00:09:33,279
zero we have a wealth of experience

277
00:09:37,269 --> 00:09:35,040
from you know building similar systems

278
00:09:39,509 --> 00:09:37,279
on the earth so we're sure we can pull

279
00:09:40,790 --> 00:09:39,519
this off

280
00:09:43,110 --> 00:09:40,800
luke i'm not sure if our viewers can

281
00:09:46,470 --> 00:09:43,120
tell but on your shirt you have a patch

282
00:09:47,910 --> 00:09:46,480
that pictures an outhouse in outer space

283
00:09:49,829 --> 00:09:47,920
there's something very humorous about

284
00:09:50,870 --> 00:09:49,839
that image but i think that there's

285
00:09:52,230 --> 00:09:50,880
something

286
00:09:55,269 --> 00:09:52,240
very indicative of what we're trying to

287
00:09:58,070 --> 00:09:55,279
accomplish here is that the real goal

288
00:10:00,310 --> 00:09:58,080

that's kind of the idea so if we have an

289
00:10:02,310 --> 00:10:00,320
express rack or type of modular system

290
00:10:04,389 --> 00:10:02,320
that we can put into the habitat

291
00:10:06,710 --> 00:10:04,399
whether that's in stage one or stage

292
00:10:09,350 --> 00:10:06,720
four of the moon base as it's built

293
00:10:10,870 --> 00:10:09,360
uh that modular architecture will be

294
00:10:13,509 --> 00:10:10,880
able to

295
00:10:15,350 --> 00:10:13,519
take in all of that waste water uh turn

296
00:10:18,389 --> 00:10:15,360
it from a hazardous commodity

297
00:10:22,470 --> 00:10:18,399
to a potable drinking water

298
00:10:24,230 --> 00:10:22,480
all in one architecture luke and daniel

299
00:10:25,590 --> 00:10:24,240
space toilets may not seem like very

300
00:10:27,350 --> 00:10:25,600
glamorous work to most

301
00:10:29,269 --> 00:10:27,360
people of earth but the work that you

302
00:10:30,150 --> 00:10:29,279
are doing is so critical to our success

303
00:10:31,990 --> 00:10:30,160
in deep space

304
00:10:33,910 --> 00:10:32,000
so thank you both uh good luck to you

305
00:10:36,710 --> 00:10:33,920
and your teams going forward

306
00:10:38,310 --> 00:10:36,720
thank you josh thank you josh all right

307
00:10:39,910 --> 00:10:38,320
that's going to do it for us here today

308
00:10:41,430 --> 00:10:39,920
appreciate you following along with us

309
00:10:42,949 --> 00:10:41,440
on this mini series

310
00:10:44,870 --> 00:10:42,959
unpacking the ways that the kennedy

311
00:10:46,550 --> 00:10:44,880
space center is involved in getting

312
00:10:47,990 --> 00:10:46,560
humans into deep space

313
00:10:49,750 --> 00:10:48,000

and some of the challenges that lie

314
00:10:50,790 --> 00:10:49,760
ahead please continue to follow along

315
00:10:52,790 --> 00:10:50,800
with our progress

316
00:10:54,790 --> 00:10:52,800
on social media and especially keep

317
00:10:56,630 --> 00:10:54,800
track of the artemis program

318
00:10:58,069 --> 00:10:56,640
uh we are focused on getting the first

319
00:10:59,590 --> 00:10:58,079
woman and next man

320
00:11:02,310 --> 00:10:59,600
on the surface of the moon by the year