
PAO

1
00:00:01,046 --> 00:00:01,586
>> Hi. Welcome

2
00:00:01,796 --> 00:00:03,866
to the International Space
Station Flight Control Room.

3
00:00:03,866 --> 00:00:05,016
It's been a busy day today.

4
00:00:05,316 --> 00:00:09,416
And we're very, very happy to
be here for talking to some

5
00:00:09,416 --> 00:00:11,686
of our students that
are actually out here

6
00:00:11,686 --> 00:00:13,466
at NASA Johnson's Space Center.

7
00:00:13,566 --> 00:00:15,716
They are the high
school aerospace scholars

8
00:00:15,716 --> 00:00:17,446
and also the pre-service
teachers.

9
00:00:17,446 --> 00:00:18,376
Today we're going to be talking

10
00:00:18,376 --> 00:00:20,786
about a very, very
popular topic.

11
00:00:21,356 --> 00:00:23,886
It's one of the letters of
the alphabet; L, M, N, O,

12
00:00:23,886 --> 00:00:28,796
P. So today I have our
guest, Julie Mitchell.

13
00:00:28,796 --> 00:00:32,116
She is the Project Engineer
of the Water Recovery System.

14
00:00:32,386 --> 00:00:32,996
Welcome, Julie.

15
00:00:32,996 --> 00:00:33,826
And thank you for coming.

16
00:00:34,006 --> 00:00:35,456
>> Thank you very
much for having me.

17
00:00:35,456 --> 00:00:35,836
>> All right.

18
00:00:35,836 --> 00:00:38,506
With that, let's get going.

19
00:00:38,686 --> 00:00:39,906
We have our first question.

20
00:00:39,906 --> 00:00:42,476
>> Hi. My name is Samantha.

21
00:00:42,476 --> 00:00:43,756
And I'm with PSTI.

22
00:00:43,756 --> 00:00:47,506
I was wondering if astronauts
need antibiotics in space?

23

00:00:47,506 --> 00:00:48,906
How would they be administered?

24
00:00:49,446 --> 00:00:50,466
>> Hi, Samantha.

25
00:00:51,176 --> 00:00:55,216
In terms of any kind medicine
that the astronauts need

26
00:00:55,216 --> 00:00:58,706
when they're in space they
actually have a medical kit

27
00:00:58,706 --> 00:00:59,766
that they bring up with them,

28
00:00:59,766 --> 00:01:02,486
and they actually have medicines
stored on the space station.

29
00:01:02,536 --> 00:01:07,416
So if they ever get sick, they
can actually use that stockpile

30
00:01:07,416 --> 00:01:09,076
of medicine that
they have on orbit.

31
00:01:09,426 --> 00:01:10,346
Now if something we're to come

32
00:01:10,346 --> 00:01:13,706
up where the astronauts were
very, very sick and the medicine

33
00:01:13,706 --> 00:01:16,366
that they had on orbit wouldn't
work, there is the option

34
00:01:16,366 --> 00:01:18,416
of bringing the crew
members down for them

35
00:01:18,486 --> 00:01:20,116
to receive medical
treatment on earth.

36
00:01:20,116 --> 00:01:24,856
But they do have quite a bit of
medicine on orbit to help them

37
00:01:24,856 --> 00:01:27,096
if they ever get sick.

38
00:01:27,096 --> 00:01:27,716
>> [inaudible] question.

39
00:01:27,716 --> 00:01:27,976
>> Thank you.

40
00:01:28,516 --> 00:01:33,556
[ Pause ]

41
00:01:34,056 --> 00:01:34,986
>> Hi. My name is Moran.

42
00:01:34,986 --> 00:01:38,196
And I was wondering how
does an astronaut keep safe

43
00:01:38,196 --> 00:01:41,786
from pathogens and
bacteria while in space?

44
00:01:41,866 --> 00:01:43,076
>> That's a really
good question.

45
00:01:43,746 --> 00:01:46,776
Before the astronauts go up
into space they actually are

46
00:01:46,776 --> 00:01:48,536
quarantined for a
certain period of time.

47
00:01:48,786 --> 00:01:50,716
I believe it's a
week or two weeks,

48
00:01:51,186 --> 00:01:52,776
and that way before they even go

49
00:01:52,776 --> 00:01:55,446
into space they've already
been isolated from a lot

50
00:01:55,446 --> 00:01:57,276
of the bacteria and a
lot of the pathogens

51
00:01:57,586 --> 00:01:59,606
that might make them sick
when they're here on earth,

52
00:01:59,656 --> 00:02:01,336
so that way they
don't carry those bugs

53
00:02:01,336 --> 00:02:02,956
up with them into space.

54
00:02:02,956 --> 00:02:07,536
Now once they're in space the
space station is actually kept

55
00:02:07,536 --> 00:02:08,236

very clean.

56
00:02:08,846 --> 00:02:10,976
They actually do a
lot of disinfection

57
00:02:11,106 --> 00:02:12,906
of different surfaces on orbit.

58
00:02:12,906 --> 00:02:14,606
They have filters
that filter the air,

59
00:02:15,016 --> 00:02:17,496
and just to make sure they
actually have different

60
00:02:17,496 --> 00:02:20,426
microbial monitoring kits
that they use to check

61
00:02:20,426 --> 00:02:22,536
for any bacteria, any pathogens

62
00:02:22,536 --> 00:02:24,146
that might be floating
around in the air.

63
00:02:24,476 --> 00:02:27,016
They check different surfaces
to see if they have any growth

64
00:02:27,016 --> 00:02:31,526
on those surfaces, and they also
check all the different hardware

65
00:02:31,526 --> 00:02:34,926
where they might get water or
where their food might touch

66
00:02:34,926 --> 00:02:37,566
to make sure that they don't
have any harmful bacteria

67
00:02:37,656 --> 00:02:39,986
or any pathogens growing
on those surfaces as well.

68
00:02:39,986 --> 00:02:42,146
And so far there haven't been
any issues in that regard.

69
00:02:42,246 --> 00:02:43,356
So it's a good thing.

70
00:02:44,346 --> 00:02:45,286
>> Very good question.

71
00:02:45,286 --> 00:02:45,896
Do we have another one?

72
00:02:46,516 --> 00:02:50,546
[ Pause ]

73
00:02:51,046 --> 00:02:53,516
>> Hi. My name is
Alexandra Daglio from PSTI.

74
00:02:53,516 --> 00:02:56,596
I was wondering what's the most
complicated project you've ever

75
00:02:56,596 --> 00:02:59,256
worked on?

76
00:02:59,646 --> 00:03:01,646
>> We do a lot of
complicated projects.

77
00:03:01,856 --> 00:03:03,086
So the area I work

78
00:03:03,086 --> 00:03:05,986
in is actually Advanced
Watery Recovery Systems,

79
00:03:06,016 --> 00:03:07,136
technology development.

80
00:03:07,136 --> 00:03:10,236
And so we actually do
the next-generation

81
00:03:10,236 --> 00:03:12,826
of water recycling
technologies for space flight.

82
00:03:12,886 --> 00:03:15,926
So right now we have the
distillation system that we use

83
00:03:15,926 --> 00:03:19,546
on the space station, but the
work that I do actually looks

84
00:03:19,546 --> 00:03:20,796
at what we're going to do next

85
00:03:20,796 --> 00:03:22,126
and if there are
other technologies

86
00:03:22,126 --> 00:03:23,956
that might work better
once we're

87
00:03:23,956 --> 00:03:25,696
on a planetary surface,

for instance.

88
00:03:26,166 --> 00:03:28,926
So the most complicated project,
I would say, is actually one

89
00:03:28,926 --> 00:03:30,216
that I'm working on right now

90
00:03:30,216 --> 00:03:32,546
and it's called the
Alternative Water Processor.

91
00:03:32,996 --> 00:03:37,146
And what it does is it actually
combines biological water

92
00:03:37,146 --> 00:03:40,776
processor in a membrane
system to get the water

93
00:03:40,776 --> 00:03:42,826
from wastewater to potable.

94
00:03:43,226 --> 00:03:46,006
And so the way that biological
water processor works is we

95
00:03:46,006 --> 00:03:49,326
actually have specific
species of bacteria

96
00:03:49,326 --> 00:03:51,656
that actually feed off
of the contaminants

97
00:03:51,656 --> 00:03:52,726
that you find in wastewater.

98

00:03:52,726 --> 00:03:55,516
So they feed off of the
urea that you find in urine.

99
00:03:55,896 --> 00:03:57,986
They feed off of the
surfactants that you find

100
00:03:57,986 --> 00:03:59,396
in soap and gray water.

101
00:03:59,866 --> 00:04:03,836
And so those bacteria
are specially selected

102
00:04:04,166 --> 00:04:07,186
so that they can actually
convert those contaminants

103
00:04:07,236 --> 00:04:09,826
into nitrogen gas,
carbon dioxide and water,

104
00:04:09,826 --> 00:04:12,826
which is like excellent
for space flight.

105
00:04:13,216 --> 00:04:16,526
Downstream of that we have
a membrane system that deals

106
00:04:16,526 --> 00:04:18,646
with all the inorganic, so
all the salts that you have

107
00:04:18,646 --> 00:04:22,046
in your urine, like calcium,
sodium, sulfates, phosphates.

108
00:04:22,046 --> 00:04:22,776

That kind of thing.

109
00:04:23,066 --> 00:04:25,196
Those things get removed
by the membrane system.

110
00:04:25,196 --> 00:04:28,466
And so what comes out of
that system, we're expecting,

111
00:04:28,876 --> 00:04:30,976
will be water that's
nearly potable.

112
00:04:30,976 --> 00:04:34,246
And so that's an incredibly
large complex piece of hardware.

113
00:04:34,246 --> 00:04:36,226
Our entire team is
working on it.

114
00:04:36,226 --> 00:04:39,956
And so it's very complex but
it's also very exciting as well.

115
00:04:40,876 --> 00:04:41,596
>> A very good one.

116
00:04:41,596 --> 00:04:41,776
>> All right.

117
00:04:41,776 --> 00:04:41,976
Thank you.

118
00:04:42,516 --> 00:04:47,556
[ Pause ]

119
00:04:48,056 --> 00:04:49,776

>> Hi. My name is
Stephanie Carol.

120
00:04:49,776 --> 00:04:51,056
And I'm from PSTI program.

121
00:04:51,186 --> 00:04:54,336
And my question is what is the
process of pre-treating urine?

122
00:04:55,676 --> 00:04:56,886
>> That's a really
good question.

123
00:04:58,266 --> 00:05:00,916
So when -- let me
step back a little bit

124
00:05:00,916 --> 00:05:02,606
and explain why we
pre-treat urine.

125
00:05:03,196 --> 00:05:10,246
So when an astronaut urinates in
space, we don't necessarily get

126
00:05:10,246 --> 00:05:12,486
to recycle the water from
that urine immediately.

127
00:05:12,856 --> 00:05:16,026
And so sometimes that urine can
sit around for a couple of days

128
00:05:16,026 --> 00:05:17,336
up to a couple of weeks.

129
00:05:17,706 --> 00:05:20,516
And so what we want to do is
we want to make sure that,

130
00:05:20,556 --> 00:05:23,556
that urine doesn't break
down chemically because,

131
00:05:23,726 --> 00:05:26,766
when it breaks down, it
can produce toxic gases,

132
00:05:26,766 --> 00:05:28,616
like ammonia gas, that
you don't want building

133
00:05:28,616 --> 00:05:30,016
up on your spacecraft.

134
00:05:30,496 --> 00:05:34,156
Also we don't want microbial
growth on the spacecraft.

135
00:05:34,156 --> 00:05:36,866
So if you've ever put a
piece of pizza or something

136
00:05:37,176 --> 00:05:39,646
in your fridge and you let
it sit there for a long time,

137
00:05:39,646 --> 00:05:40,856
and you get a piece
of, you know,

138
00:05:40,856 --> 00:05:43,386
a big mold growing
on the surface of it.

139
00:05:43,386 --> 00:05:46,116
That's the kind of thing we want
to avoid on the space station.

140
00:05:46,116 --> 00:05:49,346
If you imagine a big
fungal mat or piece of mold

141
00:05:49,346 --> 00:05:51,956
in a tube that's
about this big around,

142
00:05:51,996 --> 00:05:54,316
it can get clogged very quickly.

143
00:05:54,316 --> 00:05:57,166
And so that can actually damage
the hardware to the point

144
00:05:57,166 --> 00:05:58,466
where we can't recycle water.

145
00:05:59,046 --> 00:06:02,496
So we pre-treat the urine to
prevent the chemical breakdown

146
00:06:02,496 --> 00:06:05,476
of the urine and to
inhibit microbial growth.

147
00:06:05,986 --> 00:06:09,306
So the pretreatment process is
actually pretty straightforward.

148
00:06:09,306 --> 00:06:11,866
We have a tank that's filled
with the pretreatment fluid,

149
00:06:12,306 --> 00:06:14,196
which is about the most --

150
00:06:14,356 --> 00:06:18,606
one of the most powerful

disinfectants that you can have.

151
00:06:18,606 --> 00:06:21,646
It's a mixture of sulfuric
acid and chromic acid.

152
00:06:21,696 --> 00:06:23,496
So you don't want to
get this on your skin.

153
00:06:23,496 --> 00:06:24,536
You don't want to drink it.

154
00:06:24,836 --> 00:06:25,956
The astronauts don't drink it.

155
00:06:26,306 --> 00:06:29,656
But we put it in the urine
to prevent microbial growth

156
00:06:29,656 --> 00:06:32,066
until we can extract the
water from that urine.

157
00:06:32,096 --> 00:06:33,906
And so we have a tank
full of that fluid.

158
00:06:34,076 --> 00:06:36,966
And whenever an astronaut
urinates a certain amount

159
00:06:36,966 --> 00:06:39,276
of that fluid is injected
into the urine each time

160
00:06:39,276 --> 00:06:40,946
and then it goes
into the storage tank

161
00:06:41,566 --> 00:06:43,306
to wait until it's processed.

162
00:06:43,676 --> 00:06:44,756
>> A very good question.

163
00:06:44,756 --> 00:06:46,206
And that was a fascinating
answer.

164
00:06:46,206 --> 00:06:48,966
And I bet none of you have
ever seen the molded pizza

165
00:06:48,966 --> 00:06:49,556
in your fridge.

166
00:06:50,606 --> 00:06:51,766
Next question.

167
00:06:53,156 --> 00:06:54,676
>> Hi. My name is Whitney.

168
00:06:54,676 --> 00:06:57,006
And my question is how
is the urine contained

169
00:06:57,006 --> 00:06:59,646
until it's processed from the
time it leaves the astronaut

170
00:06:59,646 --> 00:07:00,686
to when it is processed?

171
00:07:01,916 --> 00:07:03,696
>> That's a good
question actually.

172

00:07:04,876 --> 00:07:08,466
So when the astronaut
urinates, there is a fan

173
00:07:08,466 --> 00:07:11,256
that actually sucks the
urine down through the tube

174
00:07:11,746 --> 00:07:14,116
where the astronaut
urinates, and that goes

175
00:07:14,196 --> 00:07:17,376
through a separator that
removes the gas from the urine

176
00:07:17,376 --> 00:07:20,256
and then it goes
into a storage tank.

177
00:07:20,556 --> 00:07:24,386
And depending on how much
urine we've collected

178
00:07:24,836 --> 00:07:28,716
that tank will actually
feed urine

179
00:07:28,766 --> 00:07:30,826
into our water processing
hardware.

180
00:07:31,216 --> 00:07:35,786
And so like I mentioned
before, that tank, that water,

181
00:07:36,016 --> 00:07:39,446
the urine that's in the
tank can sit for a few days

182

00:07:39,446 --> 00:07:41,676
up to a few weeks
before it's processed.

183
00:07:41,676 --> 00:07:43,836
And so you know,

184
00:07:43,836 --> 00:07:46,716
the pretreatment does this
work really in that tank,

185
00:07:46,716 --> 00:07:49,736
and then from there it
feeds into our distiller

186
00:07:49,736 --> 00:07:51,836
that actually removes
the water from the urine.

187
00:07:53,736 --> 00:07:53,976
>> Thank you.

188
00:07:54,516 --> 00:07:58,546
[ Pause ]

189
00:07:59,046 --> 00:08:00,026
>> Hello there.

190
00:08:00,026 --> 00:08:01,366
I'm Jerry George.

191
00:08:01,366 --> 00:08:03,636
I'm -- we're from
the HOSS Program.

192
00:08:03,636 --> 00:08:06,216
And I would like to
know what happens

193

00:08:06,216 --> 00:08:09,026
if someone has an infection
that goes through our urine?

194
00:08:09,236 --> 00:08:10,476
Is it safe to drink?

195
00:08:10,756 --> 00:08:13,056
And more specifically,
how did they figure

196
00:08:13,056 --> 00:08:14,306
out how to drink urine?

197
00:08:15,686 --> 00:08:16,626
>> That's a good question.

198
00:08:16,836 --> 00:08:20,666
So like I mentioned before,

199
00:08:20,666 --> 00:08:22,566
the pretreatment
does an excellent job

200
00:08:22,566 --> 00:08:24,576
of preventing any
microbial growth.

201
00:08:24,656 --> 00:08:27,626
And so it pretty much kills
everything that's in the urine.

202
00:08:28,316 --> 00:08:30,636
We haven't had any
issues in terms

203
00:08:30,636 --> 00:08:32,366
of pathogens making their way

204

00:08:32,366 --> 00:08:34,036
through the water
recovery system.

205
00:08:34,036 --> 00:08:36,896
So that chromic acid and that
sulfuric acid does a really good

206
00:08:36,896 --> 00:08:39,006
job of killing any pathogens.

207
00:08:39,546 --> 00:08:41,856
If you've ever seen
Erin Brockovich,

208
00:08:42,246 --> 00:08:44,146
the people in that
movie who gets sick,

209
00:08:44,866 --> 00:08:47,286
they actually have hexavalent
chromium in their water.

210
00:08:47,536 --> 00:08:51,346
That's the stuff that we put
in the urine to kill everything

211
00:08:51,346 --> 00:08:52,716
that could grow in that urine.

212
00:08:53,286 --> 00:08:58,266
So as soon as it gets dosed with
that pretreatment any pathogens

213
00:08:58,266 --> 00:08:59,466
or any infections
that might have been

214
00:08:59,466 --> 00:09:01,776
in there are essentially

eliminated.

215
00:09:02,146 --> 00:09:06,786
And so from that wastewater
tank it goes into a distiller,

216
00:09:06,786 --> 00:09:10,026
and that distiller actually
heats the urine slightly

217
00:09:10,346 --> 00:09:13,146
to the point where you have
water vapor that's produced,

218
00:09:13,146 --> 00:09:16,556
and that vapor is actually
what's extracted from the urine

219
00:09:16,556 --> 00:09:19,236
and condensed in a
separate container and then

220
00:09:19,236 --> 00:09:21,116
from there it's not
completely potable.

221
00:09:21,116 --> 00:09:23,236
We still have a few more
steps that are followed.

222
00:09:23,606 --> 00:09:27,036
There are ion-exchange beds
that, that water goes through

223
00:09:27,346 --> 00:09:29,616
and then we add a
biocide just to make sure

224
00:09:29,616 --> 00:09:32,776
that once it is potable we

still don't have any downstream

225
00:09:32,776 --> 00:09:34,296
contamination of that water.

226
00:09:34,716 --> 00:09:40,936
And so that's the full series of
events, to remove any pathogens

227
00:09:40,936 --> 00:09:44,296
from the urine and to get it
from wastewater to potable.

228
00:09:45,556 --> 00:09:45,906
>> Very good.

229
00:09:45,946 --> 00:09:46,476
>> Thank you.

230
00:09:46,476 --> 00:09:51,486
>> Hi. I'm Colin and I'm
from the HOSS Program.

231
00:09:51,486 --> 00:09:53,096
And [inaudible] for a second.

232
00:09:53,096 --> 00:09:55,066
If there's an emergency
situation

233
00:09:55,066 --> 00:09:58,936
that requires astronauts
to evacuate on the ISS,

234
00:09:58,936 --> 00:10:02,106
what are the procedures
for them to follow?

235
00:10:02,106 --> 00:10:03,436

>> That's a really
good question.

236
00:10:03,436 --> 00:10:05,716
As part of their
training actually here

237
00:10:05,716 --> 00:10:10,146
at JFC they do a lot of
emergency evacuation procedures,

238
00:10:10,146 --> 00:10:12,776
and they have different
procedures they follow depending

239
00:10:12,776 --> 00:10:13,996
on the type of emergency.

240
00:10:13,996 --> 00:10:17,626
You have to have a fire,
if they have a cabin leak.

241
00:10:18,116 --> 00:10:19,056
Things like that.

242
00:10:19,336 --> 00:10:21,626
They practice that quite
a bit here on the ground.

243
00:10:22,026 --> 00:10:23,496
Now the first thing
they're going to try

244
00:10:23,496 --> 00:10:26,006
to do is recover the
space station in the case

245
00:10:26,006 --> 00:10:28,436
of an emergency so that
they don't have to evacuate.

246
00:10:28,806 --> 00:10:30,246
But in the instance they do have

247
00:10:30,306 --> 00:10:33,966
to evacuate they do
always have a lifeboat.

248
00:10:34,376 --> 00:10:37,456
We call it a Soyuz
spacecraft that's docked

249
00:10:37,606 --> 00:10:40,436
to the space station for them
to get into and return to Earth

250
00:10:40,436 --> 00:10:41,516
in case of an emergency.

251
00:10:42,506 --> 00:10:42,916
>> Very good.

252
00:10:42,916 --> 00:10:46,686
And also they do periodically,
while they're on board,

253
00:10:46,856 --> 00:10:50,076
they also participate
in on-board training

254
00:10:50,076 --> 00:10:53,846
so they can maintain that
proficiency and their skills

255
00:10:54,036 --> 00:10:57,506
and be ready for, if an
emergency were to occur.

256
00:10:57,506 --> 00:10:58,076

Good question.

257
00:10:58,626 --> 00:11:01,336
>> Hi. My name is Deanna.

258
00:11:01,336 --> 00:11:03,156
And I'm with the HOSS Program.

259
00:11:03,156 --> 00:11:05,776
And my question is what
are you currently doing

260
00:11:05,776 --> 00:11:09,566
to improve the efficiency rate
of the urine recycling system?

261
00:11:10,506 --> 00:11:12,036
>> That's a really
good question too.

262
00:11:13,226 --> 00:11:16,846
We actually had a
project going on right now

263
00:11:16,846 --> 00:11:19,036
to help increase the
water recovery rate

264
00:11:19,036 --> 00:11:21,756
on the space station
up to 85 percent.

265
00:11:22,056 --> 00:11:24,816
Originally we were planning
to start out with 85 percent.

266
00:11:24,816 --> 00:11:28,096
But what actually happened was
the astronaut's urine had a lot

267
00:11:28,096 --> 00:11:29,636
more calcium than we expected.

268
00:11:30,086 --> 00:11:33,496
And so that calcium
combined with the sulfate

269
00:11:33,496 --> 00:11:35,406
from our sulfuric
acid pretreatment

270
00:11:35,576 --> 00:11:38,036
and actually precipitated
out in our distiller.

271
00:11:38,446 --> 00:11:41,476
And that precipitate
is called gypsum.

272
00:11:42,126 --> 00:11:45,476
And it's the same stuff you have
in like drywall, for instance.

273
00:11:45,946 --> 00:11:47,286
So everybody seen gypsum.

274
00:11:47,716 --> 00:11:51,226
And so one of the
technologies --

275
00:11:51,226 --> 00:11:52,916
actually several of the
technologies we're looking

276
00:11:52,916 --> 00:11:57,726
at now are to either remove
the calcium or replace

277
00:11:57,726 --> 00:12:00,296

that sulfuric acid with
a different pretreatment

278
00:12:00,366 --> 00:12:02,886
so that we don't have that
precipitation problem.

279
00:12:03,226 --> 00:12:05,296
We actually have
two technologies.

280
00:12:05,296 --> 00:12:08,586
One for calcium, and one to
kind of mitigate the sulfate

281
00:12:08,926 --> 00:12:11,896
that have both been demonstrated
to work very well and allow us

282
00:12:11,896 --> 00:12:13,296
to get up to 85 percent.

283
00:12:13,746 --> 00:12:17,726
The space station program is
leaning towards the alternative

284
00:12:17,726 --> 00:12:18,596
to the sulfate.

285
00:12:18,886 --> 00:12:20,936
And so we're actually in
the process of pursuing

286
00:12:20,936 --> 00:12:22,136
that for flight right now.

287
00:12:22,136 --> 00:12:23,866
So we're hoping that
within the next year

288
00:12:23,866 --> 00:12:27,046
or two we can get the space
station from 75 percent

289
00:12:27,046 --> 00:12:28,696
up to 85 percent water recovery.

290
00:12:29,286 --> 00:12:30,136
>> [inaudible] thank you.

291
00:12:30,346 --> 00:12:37,026
>> Hello. My name is [inaudible]
from the HOSS Program.

292
00:12:37,376 --> 00:12:40,106
And you said that
after filtration

293
00:12:40,106 --> 00:12:43,626
of urine it was just
85 percent recycled.

294
00:12:43,916 --> 00:12:46,606
What are they using
to find 20 percent?

295
00:12:47,056 --> 00:12:47,356
Or?

296
00:12:47,806 --> 00:12:49,556
>> That's a good question.

297
00:12:49,716 --> 00:12:53,166
So the remainder of
what doesn't get removed

298
00:12:53,166 --> 00:12:54,816
from the urine is
called a brine.

299
00:12:55,406 --> 00:12:58,446
And right now that
brine gets put

300
00:12:58,496 --> 00:13:01,096
into brine storage containers

301
00:13:01,436 --> 00:13:03,816
and those are thrown
in the trash.

302
00:13:03,866 --> 00:13:04,756
We get rid of those.

303
00:13:05,136 --> 00:13:08,156
But if you think about
it, there's a lot of water

304
00:13:08,156 --> 00:13:09,506
in that brine that we could get.

305
00:13:09,736 --> 00:13:11,916
And so one of the
active areas of research

306
00:13:12,116 --> 00:13:16,006
in my group is called Brine
Water Recovery, which is looking

307
00:13:16,006 --> 00:13:18,846
at different ways to
extract water from the brine.

308
00:13:19,266 --> 00:13:23,966
And the reason that is
a unique challenge is

309
00:13:23,966 --> 00:13:27,126

because once you go
past, you know, 80,

310
00:13:27,126 --> 00:13:32,156
85 percent water recovery you
start precipitating solids out.

311
00:13:32,256 --> 00:13:34,276
Even with some of
these new technologies,

312
00:13:34,276 --> 00:13:36,226
like I just mentioned,
you still are going

313
00:13:36,226 --> 00:13:37,466
to precipitate at some point.

314
00:13:37,876 --> 00:13:41,456
And so with this brine water
recovery technology we have

315
00:13:41,456 --> 00:13:44,676
to specifically design it to be
tolerant to solids formation.

316
00:13:44,976 --> 00:13:49,006
And so we're hoping that we
can extract the remaining water

317
00:13:49,006 --> 00:13:51,426
from that to continue
to close the water loop

318
00:13:51,426 --> 00:13:55,036
and hopefully get to, you know,
in the 90's or even higher,

319
00:13:55,736 --> 00:14:00,476
you know, full loop closure for

future spacecrafts beyond ISS.

320
00:14:00,476 --> 00:14:01,626
>> Okay. Thank you.

321
00:14:02,686 --> 00:14:05,316
>> Very good question.

322
00:14:05,316 --> 00:14:05,866
Do we have some more?

323
00:14:05,866 --> 00:14:10,776
>> Hi. My name is Katie
from the HOSS Program.

324
00:14:10,776 --> 00:14:14,006
And we were wondering
what's done with the waste

325
00:14:14,006 --> 00:14:15,296
that cannot be recycled?

326
00:14:15,526 --> 00:14:17,136
And how is it transported
back to earth?

327
00:14:18,556 --> 00:14:22,906
>> So a lot of the brine
that actually gets generated,

328
00:14:22,906 --> 00:14:25,536
like I said before, gets
thrown in the trash.

329
00:14:25,536 --> 00:14:28,836
And so a lot of that gets
burned up in the atmosphere.

330
00:14:29,496 --> 00:14:33,216

We do bring back samples of
that brine to actually analyze

331
00:14:33,216 --> 00:14:36,316
to see what is left over
after we've removed water

332
00:14:36,726 --> 00:14:37,896
from the urine.

333
00:14:38,716 --> 00:14:41,916
And so one thing we've done
as engineers is look at some

334
00:14:41,916 --> 00:14:45,046
of the chemical data
of that brine and use

335
00:14:45,046 --> 00:14:46,436
that to design our hardware.

336
00:14:46,836 --> 00:14:50,676
So astronaut urine is a lot
more concentrated, in general,

337
00:14:50,816 --> 00:14:53,376
than the urine that we
have here on the ground.

338
00:14:53,836 --> 00:14:56,386
And so we'll actually
collect urine for our testing

339
00:14:56,386 --> 00:15:00,946
and we'll add chemicals to it to
make it mimic the concentrations

340
00:15:00,946 --> 00:15:02,416
that you would see on orbit.

341
00:15:02,476 --> 00:15:06,006
And so those brine samples
really help us with that,

342
00:15:06,006 --> 00:15:08,336
and they also help us
especially with testing

343
00:15:08,626 --> 00:15:11,036
that brine water recovery
hardware I talked about.

344
00:15:11,276 --> 00:15:12,976
So hopefully we'll
get to the point

345
00:15:12,976 --> 00:15:16,486
where we can actually
recycle the water

346
00:15:16,486 --> 00:15:17,536
from the brine as well.

347
00:15:17,536 --> 00:15:20,206
But right now we throw
it in the trash, so.

348
00:15:21,916 --> 00:15:23,496
>> Thank you.

349
00:15:25,676 --> 00:15:29,286
>> Hi. My name is [inaudible]
from the PSDI Program.

350
00:15:29,596 --> 00:15:31,736
And I wanted to know are
there any major differences

351
00:15:31,736 --> 00:15:34,716

to urine in space?

352
00:15:35,486 --> 00:15:37,396
>> There are some differences.

353
00:15:37,456 --> 00:15:40,726
Like I mentioned
before, the urine that's

354
00:15:40,796 --> 00:15:42,936
in space we notice
is more concentrated

355
00:15:42,936 --> 00:15:44,476
than what we have
here on the ground.

356
00:15:44,926 --> 00:15:48,786
And the reason for that is when
you go into space the fluids

357
00:15:48,786 --> 00:15:51,616
in your body get
redistributed, because here

358
00:15:51,616 --> 00:15:53,556
on earth the fluids
are kind of drawn

359
00:15:53,556 --> 00:15:55,046
to your feet because of gravity.

360
00:15:55,406 --> 00:15:56,826
In space we don't have that.

361
00:15:57,156 --> 00:15:59,586
And so the fluids kind
of go up into your head.

362

00:15:59,586 --> 00:16:02,346
And so when astronauts first get
on orbit, you can actually see

363
00:16:02,346 --> 00:16:03,696
that their faces are very puffy.

364
00:16:04,206 --> 00:16:07,286
And so what happens in that
case is their brain interprets

365
00:16:07,286 --> 00:16:10,176
that as no, I have way
too much fluid altogether.

366
00:16:10,516 --> 00:16:11,656
I need to get rid of it.

367
00:16:12,066 --> 00:16:15,616
So that causes the astronauts
to urinate a lot more.

368
00:16:16,266 --> 00:16:18,646
Well, that can actually
cause the astronauts

369
00:16:18,646 --> 00:16:19,666
to get dehydrated.

370
00:16:19,996 --> 00:16:22,856
And so, you know, they're
very careful in terms

371
00:16:22,856 --> 00:16:24,126
of how much water they drink,

372
00:16:24,126 --> 00:16:26,786
but we still see
higher concentrations

373
00:16:26,786 --> 00:16:29,056
across the board of,
you know, calcium.

374
00:16:29,056 --> 00:16:33,866
Like I mentioned before,
all the different minerals

375
00:16:33,866 --> 00:16:35,106
and all the compounds you find

376
00:16:35,106 --> 00:16:36,856
in urine are higher
concentration.

377
00:16:37,286 --> 00:16:39,676
And so when we test
hardware here on the ground,

378
00:16:39,676 --> 00:16:41,976
we have to take that into
account to make sure that,

379
00:16:42,016 --> 00:16:43,766
you know, for things like
calcium, for instance,

380
00:16:44,076 --> 00:16:45,156
we have the right amount

381
00:16:45,346 --> 00:16:47,556
to appropriately
challenge our hardware.

382
00:16:48,166 --> 00:16:49,076
>> Thank you.

383
00:16:49,256 --> 00:16:53,286
>> I think we have time

for a few more questions.

384
00:16:53,326 --> 00:16:57,466
Do we have another one?

385
00:16:57,466 --> 00:16:59,166
>> Hello. My name is Eric
Williams and I'm here

386
00:16:59,166 --> 00:16:59,966
with the HOSS Program.

387
00:17:00,576 --> 00:17:02,186
And my question was
what are some

388
00:17:02,186 --> 00:17:04,076
of the challenges you've
encountered in working

389
00:17:04,076 --> 00:17:09,226
with other nations for systems
and stuff like this on the ISS?

390
00:17:09,336 --> 00:17:11,536
>> That's actually -- that's
a really good question too.

391
00:17:11,806 --> 00:17:17,886
Our team personally doesn't
work with international partners

392
00:17:17,886 --> 00:17:21,486
as much, but we do work with
the space station program a lot.

393
00:17:21,486 --> 00:17:23,146
And the program kind
of coordinates

394
00:17:23,216 --> 00:17:25,526
between all the different
international partners.

395
00:17:25,976 --> 00:17:28,386
And so the project
that I mentioned

396
00:17:28,416 --> 00:17:32,006
with the precipitation issue
and the water recycling system

397
00:17:32,006 --> 00:17:35,006
on ISS is something
that has to be worked

398
00:17:35,006 --> 00:17:37,656
between the US and Russia.

399
00:17:38,296 --> 00:17:42,146
And if we do end up replacing
that sulfuric acid pretreatment

400
00:17:42,146 --> 00:17:45,706
with something else, we have
to work that with the Russians

401
00:17:45,706 --> 00:17:48,556
to make sure that when it
gets installed in their system

402
00:17:49,146 --> 00:17:51,846
that their hardware is
compatible with that,

403
00:17:52,006 --> 00:17:53,356
that their hardware, you know,

404
00:17:53,356 --> 00:17:55,246

is appropriately
sized and so on.

405
00:17:55,556 --> 00:17:58,286
And so we have to work
very closely with them.

406
00:17:58,286 --> 00:18:01,576
And we have individuals on
our team who have traveled

407
00:18:01,576 --> 00:18:02,696
to Russia several times.

408
00:18:02,696 --> 00:18:05,286
And we have a lot of telecoms
and a lot of meetings to talk

409
00:18:05,286 --> 00:18:08,796
to them to make sure that
we're on the same page,

410
00:18:08,796 --> 00:18:12,296
so that when we fly this to
ISS we don't have any issues.

411
00:18:12,406 --> 00:18:14,166
So it can be a challenge.

412
00:18:14,206 --> 00:18:16,076
But you know, we all want

413
00:18:16,076 --> 00:18:17,946
to recycle more water
on the space station.

414
00:18:17,946 --> 00:18:19,336
So we're all happy
to work together.

415
00:18:19,916 --> 00:18:21,076
>> Thank you.

416
00:18:21,226 --> 00:18:26,806
>> Hi. My name is
Thomas [inaudible].

417
00:18:26,806 --> 00:18:28,006
I'm here with PSCI.

418
00:18:28,006 --> 00:18:31,826
And my question is does
microgravity have an impact

419
00:18:31,826 --> 00:18:35,876
on pH levels and urine?

420
00:18:36,826 --> 00:18:40,656
>> The pH level, specifically,
we don't see a major difference

421
00:18:40,716 --> 00:18:45,056
between what's on orbit and
what we see on the ground.

422
00:18:45,056 --> 00:18:46,516
There's a pretty wide range.

423
00:18:46,516 --> 00:18:48,346
That really depends
on your diet,

424
00:18:48,346 --> 00:18:49,806
depends on how much
water you drink.

425
00:18:49,866 --> 00:18:50,766
That kind of thing.

426
00:18:51,186 --> 00:18:55,216
And so we have some people
with fairly acidic urine,

427
00:18:55,216 --> 00:18:59,336
like pH in the fives, and then
some people with higher pH,

428
00:18:59,336 --> 00:19:03,946
you know, into the mid-six,
you know, 6.5 or so pH.

429
00:19:03,946 --> 00:19:06,856
And so really what we've
seen on orbit are pH's

430
00:19:06,856 --> 00:19:08,506
that fall into that range.

431
00:19:08,546 --> 00:19:10,156
So it's nothing outside
of the norm.

432
00:19:12,386 --> 00:19:12,686
>> Thank you.

433
00:19:13,516 --> 00:19:17,546
[ Pause ]

434
00:19:18,046 --> 00:19:19,406
>> Hi. My name is
Chelsea Weber and I'm here

435
00:19:19,406 --> 00:19:20,536
with the PSTI Program.

436
00:19:20,536 --> 00:19:22,786
And I have more of
a general question.

437
00:19:23,016 --> 00:19:26,056
Is going to the restroom in
space a complicated process?

438
00:19:26,696 --> 00:19:31,156
>> That's a really
good question too.

439
00:19:31,526 --> 00:19:35,616
I've personally never
used the ISS toilet;

440
00:19:35,616 --> 00:19:36,996
so I can't speak firsthand.

441
00:19:37,276 --> 00:19:42,026
But I have seen a footage, and
I've heard from crew members

442
00:19:42,336 --> 00:19:45,356
that it can be a challenge.

443
00:19:45,386 --> 00:19:50,086
The funnel that they use on
orbit to do their number one,

444
00:19:50,366 --> 00:19:56,026
it's, you know, maybe this,
about this big diameter

445
00:19:56,436 --> 00:19:58,186
and so you have to
have good aim.

446
00:19:58,326 --> 00:20:03,796
There's a fan in there to kind
of help suction it in but,

447

00:20:03,796 --> 00:20:05,766
you know, I've heard
that it can be messy.

448
00:20:05,766 --> 00:20:09,866
And so right next to the toilet
they have actually a series of,

449
00:20:09,926 --> 00:20:13,276
you know, baby wipes,
gloves that you can put

450
00:20:13,276 --> 00:20:16,176
on in case you don't
have such good aim,

451
00:20:16,696 --> 00:20:20,616
lots of several different
kinds of toilet paper.

452
00:20:20,616 --> 00:20:21,396
That kind of thing.

453
00:20:21,826 --> 00:20:24,066
And so it can be a challenge.

454
00:20:24,066 --> 00:20:26,576
But I've heard that once you get
to -- once you get used to it

455
00:20:26,576 --> 00:20:28,586
and once you get the technique
down it's not too bad.

456
00:20:28,586 --> 00:20:29,476
>> Okay. Thank you.

457
00:20:30,016 --> 00:20:33,176
>> I want to know about
the L, M, N, O, P?

458
00:20:33,316 --> 00:20:34,906
>> Good question.

459
00:20:34,906 --> 00:20:37,846
Do we have another one?

460
00:20:37,846 --> 00:20:39,936
>> Yes. I'm Katie
Snyder with HOSS.

461
00:20:39,936 --> 00:20:41,896
And I'd like to know
how much education

462
00:20:41,896 --> 00:20:45,926
and training did you go
through to get your position?

463
00:20:45,976 --> 00:20:49,096
>> So I actually
have two degrees.

464
00:20:49,096 --> 00:20:51,006
I have one in aerospace
engineering

465
00:20:51,006 --> 00:20:52,576
and another degree in geology.

466
00:20:52,576 --> 00:20:56,676
Those aren't directly
applicable to what I do,

467
00:20:56,806 --> 00:20:59,606
but it's really the
problem-solving mindset

468
00:21:00,056 --> 00:21:03,876

and the background knowledge
and engineering principles

469
00:21:03,936 --> 00:21:05,406
in chemistry and physics

470
00:21:05,796 --> 00:21:07,646
that have really
helped me with my job.

471
00:21:07,856 --> 00:21:11,556
So if you look at the entire
water recovery system's team,

472
00:21:12,036 --> 00:21:13,616
we have civil engineers.

473
00:21:13,676 --> 00:21:16,776
We have mechanical engineers,
electrical engineers.

474
00:21:17,036 --> 00:21:20,486
We also have several chemists
that work in the lab with us.

475
00:21:20,486 --> 00:21:24,286
We have a micro biologist
who helps us, for instance,

476
00:21:24,486 --> 00:21:28,636
when we're evaluating whether
pretreatment is working or not.

477
00:21:28,636 --> 00:21:30,296
They're able to actually
plate those samples

478
00:21:30,296 --> 00:21:33,536
out on petri dishes and see
what's growing and how much.

479
00:21:33,936 --> 00:21:37,386
And so you know, pretty
much any kind of engineering

480
00:21:37,386 --> 00:21:42,156
or science discipline would
get someone to this position

481
00:21:43,286 --> 00:21:44,676
to be able to do
this kind of work.

482
00:21:44,676 --> 00:21:45,716
But for me personally,

483
00:21:45,716 --> 00:21:47,696
I did aerospace engineering
and geology.

484
00:21:49,716 --> 00:21:50,316
>> Thank you very much.

485
00:21:50,316 --> 00:21:54,516
>> Hi. My name is
Catrina Cotrone.

486
00:21:54,516 --> 00:21:55,606
So much of that.

487
00:21:55,816 --> 00:21:57,946
How did you get into
this profession?

488
00:21:57,946 --> 00:22:00,136
Because I know maybe at like
five years old you didn't know

489
00:22:00,136 --> 00:22:01,586

you're going to be
a urine specialist.

490
00:22:01,586 --> 00:22:06,276
So how did you -- how
is the practice of that?

491
00:22:07,236 --> 00:22:08,156
>> That's a good question.

492
00:22:08,346 --> 00:22:11,856
I've always been interested
in space since I was a kid.

493
00:22:11,856 --> 00:22:14,436
Space travel has always
been fascinating to me.

494
00:22:14,916 --> 00:22:20,016
As I got older though it became
more of a question of survival

495
00:22:20,466 --> 00:22:25,556
and what can we do to make sure
our species is around long-term.

496
00:22:26,116 --> 00:22:29,096
And so going through
school I started thinking

497
00:22:29,096 --> 00:22:33,736
about human space flight and
the fact that we have to set

498
00:22:33,736 --> 00:22:36,296
up habitats on the
moon and on Mars.

499
00:22:36,296 --> 00:22:39,056
And like, we have on the

space station right now,

500
00:22:39,056 --> 00:22:43,896
we need permanent habitats
in space if we're going

501
00:22:43,896 --> 00:22:45,366
to continue as a species.

502
00:22:45,926 --> 00:22:51,246
And so that actually drove me
towards spacecraft engineering.

503
00:22:51,246 --> 00:22:54,276
So I did aerospace
engineering initially

504
00:22:54,276 --> 00:22:56,246
and I added geology after that.

505
00:22:56,646 --> 00:23:01,126
I found out about a program
called the Cooperative Education

506
00:23:01,126 --> 00:23:04,086
Program, at least that's what
it was called at the time.

507
00:23:04,516 --> 00:23:07,996
And that actually allows
students who are in college

508
00:23:07,996 --> 00:23:12,116
to come and work
full-time at a NASA center.

509
00:23:12,466 --> 00:23:15,866
And so I had the
opportunity to come to JFC.

510
00:23:16,696 --> 00:23:19,626
And I learned about a
group called the Crew

511
00:23:19,626 --> 00:23:21,116
and Thermal Systems Division.

512
00:23:21,516 --> 00:23:24,846
And this is a group within
engineering that just focuses

513
00:23:24,846 --> 00:23:28,266
on -- they have thermals, you
know, thermal control as well,

514
00:23:28,266 --> 00:23:31,046
which is cool, but I
really like the crew side.

515
00:23:31,086 --> 00:23:33,086
And how do we keep
people alive in space?

516
00:23:33,086 --> 00:23:36,026
Because to me that comes back
to that survival question of,

517
00:23:36,426 --> 00:23:38,936
you know, how do we
continue species?

518
00:23:38,936 --> 00:23:41,196
And how do we keep ourselves
around for a long time?

519
00:23:41,516 --> 00:23:44,756
And so within that crew
aspect there are a number

520

00:23:44,756 --> 00:23:47,526
of different groups,
people that work

521
00:23:47,646 --> 00:23:50,926
on atmosphere revitalization;
so recycling the air

522
00:23:50,926 --> 00:23:54,526
on the spacecraft, people
who work on habitability;

523
00:23:54,526 --> 00:23:56,696
so the people who
actually design the toilet.

524
00:23:57,256 --> 00:24:00,156
They design the galley and
so on, on the space station

525
00:24:00,536 --> 00:24:03,376
and then also the
water recycling team.

526
00:24:03,576 --> 00:24:06,616
And so I able to kind
of work my way in there.

527
00:24:06,926 --> 00:24:09,736
And they had an opening on the
water team and so I was able

528
00:24:09,796 --> 00:24:11,486
to come on board
and start with them.

529
00:24:11,576 --> 00:24:17,096
So that working full-time at JFC
as a student really helped me

530

00:24:17,096 --> 00:24:19,536
to kind of pinpoint what
area I wanted to go in.

531
00:24:20,416 --> 00:24:21,476
>> Excellent.

532
00:24:21,736 --> 00:24:23,596
[multiple speakers] question
and excellent answer.

533
00:24:23,596 --> 00:24:25,816
Thank you very much for
coming out and talk.

534
00:24:25,816 --> 00:24:28,936
I think that's all
the time that we have.

535
00:24:29,156 --> 00:24:31,676
Guys, thank you for coming in.

536
00:24:31,676 --> 00:24:33,436
And thanks for the
excellent questions.

537
00:24:34,136 --> 00:24:35,156
>> Thank you for having me.