1
00:00:06,869 --> 00:00:05,579
one of the main emissions of the

2
00:00:08,790 --> 00:00:06,879
International Space Station is to

3
00:00:10,140 --> 00:00:08,800
provide us a way to learn what it's

4
00:00:11,970 --> 00:00:10,150
going to take for humans to live in

5
00:00:13,710 --> 00:00:11,980
space a long term and that covers

6
00:00:15,870 --> 00:00:13,720
everything from what the absence of

7
00:00:18,060 --> 00:00:15,880
gravity does to astronauts bones and

8
00:00:19,950 --> 00:00:18,070
muscles and also all the way down to

9
00:00:23,249 --> 00:00:19,960
more simple things like what it's like

10
00:00:24,569 --> 00:00:23,259
to drink a glass of water in orbit the

11
00:00:25,829 --> 00:00:24,579
dragon cargo ship that arrived at the

12
00:00:27,419 --> 00:00:25,839
station last week is carrying an

13
00:00:29,550 --> 00:00:27,429

experiment known as the capillary

14
00:00:32,130 --> 00:00:29,560
beverage and that may change the way

15
00:00:33,570 --> 00:00:32,140
that astronauts drink in space so this

16
00:00:35,310 --> 00:00:33,580
morning we're going to learn more about

17
00:00:38,160 --> 00:00:35,320
it from the principal investigator of

18
00:00:40,140 --> 00:00:38,170
the experiment dr. mike weis local the

19
00:00:44,220 --> 00:00:40,150
vice president and senior scientists at

20
00:00:45,990 --> 00:00:44,230
the research foreign firm IRP i and a

21
00:00:48,060 --> 00:00:46,000
professor of mechanical engineering at

22
00:00:50,370 --> 00:00:48,070
Portland State University in Portland

23
00:00:54,480 --> 00:00:50,380
Oregon mark yes

24
00:00:55,500 --> 00:00:54,490
thanks so much for joining us so you

25
00:00:57,030 --> 00:00:55,510
know I shouldn't have been straight

26
00:00:59,700 --> 00:00:57,040
drinking through straws all these years

27
00:01:01,880 --> 00:00:59,710
I guess are there are there reasons to

28
00:01:04,109 --> 00:01:01,890
change that or their disadvantages to it

29
00:01:07,499 --> 00:01:04,119
well there are certainly reasons to do

30
00:01:09,510 --> 00:01:07,509
it I mean you can imagine flavored

31
00:01:11,249 --> 00:01:09,520
drinks being reconstituted from powders

32
00:01:13,590 --> 00:01:11,259
being an absolute nightmare with gravity

33
00:01:16,889 --> 00:01:13,600
gun and it's a real challenge problem

34
00:01:18,239 --> 00:01:16,899
and solved by having it done in a bag it

35
00:01:21,179 --> 00:01:18,249
doesn't mean there aren't any hazards

36
00:01:22,739 --> 00:01:21,189
with bags you could easily hiccup with

37
00:01:24,059 --> 00:01:22,749
your hand holding one of the bags and

38
00:01:26,459 --> 00:01:24,069

you would squeeze the bag and send out a

39
00:01:27,840 --> 00:01:26,469
jet of liquid you know or you could that

40
00:01:29,849 --> 00:01:27,850
kind of thing there are still some

41
00:01:34,319 --> 00:01:29,859
hazards with it but confined to the

42
00:01:35,730 --> 00:01:34,329
galley it's probably okay with a cup the

43
00:01:37,770 --> 00:01:35,740
astronauts would have an experience kind

44
00:01:39,419 --> 00:01:37,780
of like Earth and you'd be able to smell

45
00:01:42,410 --> 00:01:39,429
the aromas and you'd be able to

46
00:01:44,370 --> 00:01:42,420
experience that kind of bonding

47
00:01:46,080 --> 00:01:44,380
phenomenon that takes place when you're

48
00:01:47,849 --> 00:01:46,090
drinking a cup of coffee with friends

49
00:01:50,279 --> 00:01:47,859
during a break and that can relieve some

50
00:01:52,169 --> 00:01:50,289
of those stresses that are up there so

51
00:01:55,020 --> 00:01:52,179
there definitely I guess a psychological

52
00:01:57,149 --> 00:01:55,030
advantage to that experience to making

53
00:01:58,889 --> 00:01:57,159
the connection yes there is that there

54
00:02:01,289 --> 00:01:58,899
there could also be one for instance

55
00:02:03,029 --> 00:02:01,299
picturing a long-duration mission where

56
00:02:05,249 --> 00:02:03,039
you use reusable cups instead of

57
00:02:08,969 --> 00:02:05,259
thousands of disposable drink bags you

58
00:02:12,600 --> 00:02:08,979
can expect maybe a significant savings

59
00:02:16,770 --> 00:02:12,610
in volume and mass also but here this

60
00:02:19,830 --> 00:02:16,780
is largely about fun and that was the

61
00:02:21,240 --> 00:02:19,840
idea about it in the first place and I

62
00:02:25,530 --> 00:02:21,250
can tell you more about that if you want

63
00:02:26,880 --> 00:02:25,540

to but whatever okay well let's back up

64
00:02:28,770 --> 00:02:26,890
just a little bit I know this builds on

65
00:02:31,260 --> 00:02:28,780
some earlier experiments that weren't I

66
00:02:33,690 --> 00:02:31,270
guess necessarily aimed at such a fun

67
00:02:35,280 --> 00:02:33,700
experiment but in capillary flow can you

68
00:02:37,080 --> 00:02:35,290
just kind of go back and explain a

69
00:02:39,060 --> 00:02:37,090
little bit about that for us okay so

70
00:02:40,980 --> 00:02:39,070
we've been doing a lot of work in drop

71
00:02:42,390 --> 00:02:40,990
towers and low gravity aircraft and

72
00:02:44,850 --> 00:02:42,400
shuttle experiments and things over the

73
00:02:46,590 --> 00:02:44,860
years and recently I'd say over the last

74
00:02:48,360 --> 00:02:46,600
eight years or so we've had several a

75
00:02:50,190 --> 00:02:48,370
slew of experiments that the astronauts

76
00:02:51,900 --> 00:02:50,200
have performed as well as robotic

77
00:02:54,660 --> 00:02:51,910
experiments that that all look at how

78
00:02:56,820 --> 00:02:54,670
liquids behave when gravity the effects

79
00:02:58,729 --> 00:02:56,830
of gravity are small so what we're doing

80
00:03:03,390 --> 00:02:58,739
is we're changing the shapes of

81
00:03:05,360 --> 00:03:03,400
containers and in such a manner that the

82
00:03:08,970 --> 00:03:05,370
liquid moves to the right locations

83
00:03:10,740 --> 00:03:08,980
passively spontaneously and it's driven

84
00:03:13,620 --> 00:03:10,750
by surface tension and wetting forces

85
00:03:15,150 --> 00:03:13,630
but it's also crazy geometry and we're

86
00:03:16,590 --> 00:03:15,160
developing the methods to do that so

87
00:03:19,259 --> 00:03:16,600
that you don't use pumps you don't use

88
00:03:21,810 --> 00:03:19,269

centrifuge you don't need gravity the

89
00:03:23,880 --> 00:03:21,820
container determines its own bottom and

90
00:03:25,470 --> 00:03:23,890
so where you know where the liquid is

91
00:03:27,840 --> 00:03:25,480
when it's time to use it we're trying to

92
00:03:29,640 --> 00:03:27,850
make plumbing in space mundane instead

93
00:03:32,190 --> 00:03:29,650
of this aggravating you know scary

94
00:03:35,310 --> 00:03:32,200
actionable process it's a terrible thing

95
00:03:37,650 --> 00:03:35,320
to try to flush the toilet for instance

96
00:03:40,650 --> 00:03:37,660
and then where's the water or to drain

97
00:03:44,400 --> 00:03:40,660
the fuel tank but where's the fuel that

98
00:03:48,060 --> 00:03:44,410
kind of thing to feed to drink feed the

99
00:03:49,650 --> 00:03:48,070
mice with with water at least but

100
00:03:51,570 --> 00:03:49,660
where's the water that kind of thing so

101
00:03:52,890 --> 00:03:51,580
we want that to be passive we wanted

102
00:03:55,470 --> 00:03:52,900
that to be mundane we want those

103
00:03:57,390 --> 00:03:55,480
challenges to go away and these are and

104
00:04:02,009 --> 00:03:57,400
the coffee cup for instance or the the

105
00:04:04,830 --> 00:04:02,019
beverage is an example of how we can do

106
00:04:07,740 --> 00:04:04,840
this in a day to day you know living in

107
00:04:09,720 --> 00:04:07,750
space kind of way so that's just a very

108
00:04:12,630 --> 00:04:09,730
practical example of the research you've

109
00:04:16,770 --> 00:04:12,640
been doing right I think so

110
00:04:18,990 --> 00:04:16,780
what spawned it was this the Italian

111
00:04:21,390 --> 00:04:19,000
espresso machine the is espresso that's

112
00:04:24,240 --> 00:04:21,400
going up and the fact that there's these

113
00:04:25,790 --> 00:04:24,250

complex drinks that are up there and

114
00:04:30,950 --> 00:04:25,800
then it just steamrolled from

115
00:04:32,839 --> 00:04:30,960
but thanks for something like this well

116
00:04:34,839 --> 00:04:32,849
I know astronaut Don Pettit created

117
00:04:36,559 --> 00:04:34,849
something that looked kind of similar

118
00:04:39,290 --> 00:04:36,569
back when he was on the space station

119
00:04:41,029 --> 00:04:39,300
and I think 2008 is that if you worked

120
00:04:50,300 --> 00:04:41,039
with him on that right did that that

121
00:04:53,089 --> 00:04:50,310
spark the idea here associated with that

122
00:04:56,360 --> 00:04:53,099
and so we emailed him hey you could do

123
00:04:57,800 --> 00:04:56,370
this and that and he went over to the he

124
00:04:59,540 --> 00:04:57,810
got some materials that were on space

125
00:05:02,749 --> 00:04:59,550
station and constructed this thing and

126
00:05:04,999 --> 00:05:02,759
that demonstrated the the phenomena and

127
00:05:07,480 --> 00:05:05,009
how you can replace the role of gravity

128
00:05:10,610 --> 00:05:07,490
with that of surface tension wetting and

129
00:05:12,890 --> 00:05:10,620
geometric shape of the container and now

130
00:05:15,619 --> 00:05:12,900
the the new one though is full-blown

131
00:05:17,930 --> 00:05:15,629
design so now here we use the design

132
00:05:19,790 --> 00:05:17,940
models that we use for industrial design

133
00:05:22,279 --> 00:05:19,800
or commercial aerospace or NASA related

134
00:05:26,089 --> 00:05:22,289
aerospace stuff bring it all together in

135
00:05:29,209 --> 00:05:26,099
us in a cup and she's complicated and

136
00:05:33,320 --> 00:05:29,219
but it can be 3d printed and here we're

137
00:05:36,800 --> 00:05:33,330
gonna dink around during meal time but

138
00:05:38,899 --> 00:05:36,810

we also to expect to get quality science

139
00:05:40,399 --> 00:05:38,909
from this to verify and validate the

140
00:05:47,480 --> 00:05:40,409
models that we use so it's really got

141
00:05:48,980 --> 00:05:47,490
this two pronged effort you know well I

142
00:05:51,019 --> 00:05:48,990
saw that the crew is actually gonna

143
00:05:53,269 --> 00:05:51,029
demonstrate these these cups today so

144
00:05:55,040 --> 00:05:53,279
what what exactly is the experiment is

145
00:05:58,459 --> 00:05:55,050
there data that they'll be collecting or

146
00:06:00,230 --> 00:05:58,469
just seeing of the world okay I think

147
00:06:02,570 --> 00:06:00,240
they're unpacking things today if

148
00:06:03,740 --> 00:06:02,580
they're actually experimenting it's new

149
00:06:05,300 --> 00:06:03,750
it's the information to me if they're

150
00:06:07,550 --> 00:06:05,310
gonna be using it today but we're on to

151
00:06:10,070 --> 00:06:07,560
our call so we're on the task list to be

152
00:06:13,219 --> 00:06:10,080
run at any time but this is this is an

153
00:06:14,899 --> 00:06:13,229
example of the cup okay so this thing's

154
00:06:18,740 --> 00:06:14,909
just a 3d printed out of a transparent

155
00:06:20,269 --> 00:06:18,750
polymer and it's been it's been run

156
00:06:22,430 --> 00:06:20,279
through a series of tests to render it

157
00:06:24,529 --> 00:06:22,440
you know say safe to drink it can be

158
00:06:26,749 --> 00:06:24,539
drink and we have go ahead for all 50

159
00:06:28,279 --> 00:06:26,759
drinks on the space station and right

160
00:06:30,019 --> 00:06:28,289
now we're touch temperature drinks but

161
00:06:32,990 --> 00:06:30,029
once we demonstrated safe then we can

162
00:06:36,019 --> 00:06:33,000
maybe pursue hot beverages like tea

163
00:06:36,409 --> 00:06:36,029

coffee things like this what was I

164
00:06:38,149 --> 00:06:36,419
saying

165
00:06:40,549 --> 00:06:38,159
oh yeah so so this

166
00:06:42,829 --> 00:06:40,559
okay this is a demitasse its first shot

167
00:06:45,559 --> 00:06:42,839
of espresso okay there are six cups like

168
00:06:46,669 --> 00:06:45,569
this on the space station this one is a

169
00:06:48,199 --> 00:06:46,679
small one the other ones are a little

170
00:06:50,149 --> 00:06:48,209
larger some with handles some with

171
00:06:52,239 --> 00:06:50,159
different shapes the astronaut will use

172
00:06:54,529 --> 00:06:52,249
a drink bag to fill the cup and then

173
00:06:58,159 --> 00:06:54,539
enjoy it in the galley

174
00:06:59,419 --> 00:06:58,169
just drinking like this so once a

175
00:07:01,040 --> 00:06:59,429
connection is made with the lip the

176
00:07:02,809 --> 00:07:01,050
entire contents can be drained into the

177
00:07:04,399 --> 00:07:02,819
mouth and it'll be pretty much like a

178
00:07:07,159 --> 00:07:04,409
drink experience the nose will be

179
00:07:08,600 --> 00:07:07,169
centered over little over the opening so

180
00:07:10,639 --> 00:07:08,610
you'll get a nice whiff of whatever

181
00:07:13,549 --> 00:07:10,649
it'll feel somewhat like earth it'll be

182
00:07:16,339 --> 00:07:13,559
different you'll adapt but it'll have

183
00:07:18,919 --> 00:07:16,349
much that same feeling the thing is only

184
00:07:22,009 --> 00:07:18,929
20% of the activities though are for fun

185
00:07:23,809 --> 00:07:22,019
in the galley 80% of the effort is

186
00:07:25,939 --> 00:07:23,819
actually going to be out in the in the

187
00:07:28,459 --> 00:07:25,949
in the laboratory with cameras

188
00:07:30,949 --> 00:07:28,469

orthogonal views HD visualization

189
00:07:33,889 --> 00:07:30,959
damping video and we expect to get

190
00:07:35,839 --> 00:07:33,899
profile views of good magnified profile

191
00:07:37,759 --> 00:07:35,849
views of what the surface shape looks

192
00:07:40,429 --> 00:07:37,769
like the drain rates the flow rates the

193
00:07:42,100 --> 00:07:40,439
stability everything about it and the

194
00:07:44,509 --> 00:07:42,110
point of that is to provide what we call

195
00:07:46,519 --> 00:07:44,519
validation and verification of all the

196
00:07:49,129 --> 00:07:46,529
models that we use there are complex

197
00:07:51,799 --> 00:07:49,139
drinks the wedding isn't perfect all of

198
00:07:53,209 --> 00:07:51,809
these things that all will will actually

199
00:07:54,859 --> 00:07:53,219
really improve our knowledge for

200
00:07:57,679 --> 00:07:54,869
designing systems for wastewater

201
00:07:59,419 --> 00:07:57,689
processing on Space Station for drinks

202
00:08:01,419 --> 00:07:59,429
perhaps you know how how you process

203
00:08:04,339 --> 00:08:01,429
urine and brines and things downstream

204
00:08:06,019 --> 00:08:04,349
condensates water water supply this kind

205
00:08:07,999 --> 00:08:06,029
of stuff so it's actually going to be

206
00:08:09,379 --> 00:08:08,009
very valuable data to us and we actually

207
00:08:11,239 --> 00:08:09,389
want to turn around and use it for

208
00:08:13,100 --> 00:08:11,249
advanced systems design that's that's

209
00:08:14,959 --> 00:08:13,110
our intention well that's a great way to

210
00:08:17,299 --> 00:08:14,969
test it it sounds fascinating so we

211
00:08:19,009 --> 00:08:17,309
can't wait to see the crew hopefully

212
00:08:20,600 --> 00:08:19,019
using them pretty soon and definitely

213
00:08:22,519 --> 00:08:20,610

the results as they start to come in

214
00:08:24,350 --> 00:08:22,529
thank you so much for joining us mark we

215
00:08:25,879 --> 00:08:24,360
really appreciate it and again that was

216
00:08:28,149 --> 00:08:25,889
a mark wise local who's the vice