



**SPACESTATION
LIVE**

1
00:00:08,950 --> 00:00:07,349
much of the science research on the

2
00:00:10,629 --> 00:00:08,960
international space station is devoted

3
00:00:12,470 --> 00:00:10,639
to learning more about how the human

4
00:00:14,390 --> 00:00:12,480
body deals with being in the weightless

5
00:00:15,829 --> 00:00:14,400
environment for a long period of time

6
00:00:18,230 --> 00:00:15,839
which will be the case during future

7
00:00:21,189 --> 00:00:18,240
missions to explore deep space

8
00:00:23,189 --> 00:00:21,199
one way to determine how people respond

9
00:00:26,070 --> 00:00:23,199
to changes in their environment is to

10
00:00:27,990 --> 00:00:26,080
sequence their dna and rna

11
00:00:30,230 --> 00:00:28,000
and now there is a portable tool

12
00:00:32,630 --> 00:00:30,240
designed for that task that is being

13
00:00:34,950 --> 00:00:32,640

tested on orbit it's called the

14

00:00:36,790 --> 00:00:34,960

biomolecule sequencer and this morning

15

00:00:38,869 --> 00:00:36,800

we're going to learn about that from the

16

00:00:42,069 --> 00:00:38,879

principal investigator dr aaron burton

17

00:00:43,430 --> 00:00:42,079

of the nasa johnson space center

18

00:00:44,790 --> 00:00:43,440

good morning welcome and thank you for

19

00:00:46,630 --> 00:00:44,800

joining us here at the international

20

00:00:49,350 --> 00:00:46,640

space station flight control room dr

21

00:00:50,790 --> 00:00:49,360

aaron burton thank you for joining us

22

00:00:52,709 --> 00:00:50,800

uh thanks for having me uh it's a

23

00:00:55,029 --> 00:00:52,719

pleasure to be here wait well let's

24

00:00:56,790 --> 00:00:55,039

first talk about the um

25

00:00:58,470 --> 00:00:56,800

the sequence in research can you explain

26

00:01:00,790 --> 00:00:58,480

to me just briefly how

27

00:01:02,950 --> 00:01:00,800

how did you get interested in in doing

28

00:01:04,789 --> 00:01:02,960

this research yeah well in uh graduate

29

00:01:06,789 --> 00:01:04,799

school i worked with functional rna

30

00:01:08,550 --> 00:01:06,799

molecules uh and we would look at the

31

00:01:09,910 --> 00:01:08,560

effects of mutations and how that

32

00:01:12,870 --> 00:01:09,920

changed the function

33

00:01:15,109 --> 00:01:12,880

uh of the molecule and so we did a lot

34

00:01:16,950 --> 00:01:15,119

of sequencing um

35

00:01:18,310 --> 00:01:16,960

from that perspective

36

00:01:21,270 --> 00:01:18,320

and so this

37

00:01:22,789 --> 00:01:21,280

project is kind of uh building on that

38

00:01:25,670 --> 00:01:22,799

research where we're looking at changes

39

00:01:28,310 --> 00:01:25,680

in dna and rna and how they might affect

40

00:01:30,630 --> 00:01:28,320

um humans and biology in general well

41

00:01:32,550 --> 00:01:30,640

it's really interesting so um

42

00:01:34,069 --> 00:01:32,560

what's also fascinating is from what i

43

00:01:35,910 --> 00:01:34,079

understand this is the first time we've

44

00:01:39,030 --> 00:01:35,920

actually been able to do this in space

45

00:01:40,789 --> 00:01:39,040

correct yes and so can you just kind of

46

00:01:42,389 --> 00:01:40,799

run me through what is

47

00:01:44,710 --> 00:01:42,399

how is this research about going to be

48

00:01:48,069 --> 00:01:44,720

valuable to us sequencing dna and rna in

49

00:01:49,510 --> 00:01:48,079

space okay um so i like to think of dna

50

00:01:52,069 --> 00:01:49,520

as sort of like a cookbook and then the

51

00:01:55,429 --> 00:01:52,079

rna would be the

52

00:01:56,870 --> 00:01:55,439

recipes in that cookbook um right sorry

53

00:01:59,429 --> 00:01:56,880

jeans will be uh recipes in that

54

00:02:00,870 --> 00:01:59,439

cookbook and then um if you want to keep

55

00:02:03,590 --> 00:02:00,880

your cookbook nice and clean you would

56

00:02:05,350 --> 00:02:03,600

make like a photocopy of each recipe

57

00:02:07,109 --> 00:02:05,360

and then if you wanted five people to be

58

00:02:08,790 --> 00:02:07,119

able to make your cheesecake you would

59

00:02:10,309 --> 00:02:08,800

give five people those cheesecake

60

00:02:12,309 --> 00:02:10,319

recipes

61

00:02:15,510 --> 00:02:12,319

and so that's kind of

62

00:02:17,270 --> 00:02:15,520

how rna works where rna is the

63

00:02:18,309 --> 00:02:17,280

functional

64

00:02:19,589 --> 00:02:18,319

or the

65

00:02:22,390 --> 00:02:19,599

molecules

66

00:02:23,589 --> 00:02:22,400

that go on to become proteins

67

00:02:25,830 --> 00:02:23,599

and so

68

00:02:27,830 --> 00:02:25,840

how an organism is responding to

69

00:02:30,470 --> 00:02:27,840

microgravity or another environment you

70

00:02:31,270 --> 00:02:30,480

can tell from its rna so certain rnas

71

00:02:33,030 --> 00:02:31,280

will be

72

00:02:34,869 --> 00:02:33,040

increased in production and other rnas

73

00:02:37,670 --> 00:02:34,879

will be decreased and by looking at the

74

00:02:38,949 --> 00:02:37,680

changes in the levels of rna

75

00:02:40,470 --> 00:02:38,959

as a

76

00:02:42,309 --> 00:02:40,480

as the organism is responding to that

77

00:02:44,229 --> 00:02:42,319

environment you could tell oh we want

78

00:02:46,309 --> 00:02:44,239

this pathway upregulated we want this

79

00:02:48,550 --> 00:02:46,319

pathway down regulated

80

00:02:50,070 --> 00:02:48,560

and then by looking at dna sequencing

81

00:02:52,070 --> 00:02:50,080

you can look for permanent changes so

82

00:02:53,270 --> 00:02:52,080

this would be like mutations

83

00:02:56,229 --> 00:02:53,280

or things that are going to change the

84

00:02:57,990 --> 00:02:56,239

cell permanently okay and so what about

85

00:03:00,550 --> 00:02:58,000

well i guess you know characterizing

86

00:03:02,149 --> 00:03:00,560

organisms that are in their environment

87

00:03:04,470 --> 00:03:02,159

and so in space but how is this going to

88

00:03:06,630 --> 00:03:04,480

help benefit for

89

00:03:08,550 --> 00:03:06,640

deep space exploration

90

00:03:10,550 --> 00:03:08,560

so one of the the limitations we have

91

00:03:11,910 --> 00:03:10,560

for

92

00:03:13,910 --> 00:03:11,920

exploration now is that we return the

93

00:03:17,110 --> 00:03:13,920

samples to earth and that's perfectly

94

00:03:18,630 --> 00:03:17,120

fine for iss because it's pretty close

95

00:03:20,390 --> 00:03:18,640

but as we move and you want to send

96

00:03:21,509 --> 00:03:20,400

humans to mars for example it's a nine

97

00:03:23,110 --> 00:03:21,519

month journey

98

00:03:25,190 --> 00:03:23,120

roughly and so you're not going to be

99

00:03:26,550 --> 00:03:25,200

able to return samples every month

100

00:03:28,789 --> 00:03:26,560

to do that sort of thing so we'd like to

101
00:03:30,229 --> 00:03:28,799
have the ability to do these processes

102
00:03:32,630 --> 00:03:30,239
in flight

103
00:03:34,789 --> 00:03:32,640
during the course of sequencing sure

104
00:03:36,229 --> 00:03:34,799
exploration

105
00:03:38,229 --> 00:03:36,239
so i understand you brought some

106
00:03:39,910 --> 00:03:38,239
show-and-tell here this is actually the

107
00:03:41,990 --> 00:03:39,920
the device that we have now in space

108
00:03:43,670 --> 00:03:42,000
correct um so it's going to launch next

109
00:03:46,390 --> 00:03:43,680
spring okay um so we're working on

110
00:03:49,190 --> 00:03:46,400
getting it flight certified okay um yeah

111
00:03:51,910 --> 00:03:49,200
so this is um the dna sequencer and it's

112
00:03:54,149 --> 00:03:51,920
commercially available yeah so can you

113
00:03:55,670 --> 00:03:54,159

tell me run through what is the process

114

00:03:58,869 --> 00:03:55,680
of getting it certified for space and

115

00:04:00,789 --> 00:03:58,879
what will the astronauts do with it okay

116

00:04:02,550 --> 00:04:00,799
so basically uh this is the sequencer

117

00:04:05,509 --> 00:04:02,560
and then this is a flow cell and this is

118

00:04:06,309 --> 00:04:05,519
kind of where the magic happens

119

00:04:08,149 --> 00:04:06,319
so

120

00:04:09,509 --> 00:04:08,159
basically to get it certified for

121

00:04:10,470 --> 00:04:09,519
flight the most important thing so that

122

00:04:11,910 --> 00:04:10,480
we want to make sure that it's not going

123

00:04:13,030 --> 00:04:11,920
to hurt the crew

124

00:04:15,270 --> 00:04:13,040
or the

125

00:04:16,870 --> 00:04:15,280
iss itself

126
00:04:18,229 --> 00:04:16,880
and then

127
00:04:19,909 --> 00:04:18,239
we'd also like to make sure that it's

128
00:04:21,189 --> 00:04:19,919
going to work and we don't you know we

129
00:04:23,510 --> 00:04:21,199
can't really test how well it's going to

130
00:04:25,030 --> 00:04:23,520
work in microgravity because the iss is

131
00:04:26,950 --> 00:04:25,040
the only place where you can

132
00:04:30,629 --> 00:04:26,960
get sustained microgravity for you know

133
00:04:32,230 --> 00:04:30,639
the hours that a sequencer would run

134
00:04:34,070 --> 00:04:32,240
and so then

135
00:04:36,390 --> 00:04:34,080
once we actually get it in flight

136
00:04:37,830 --> 00:04:36,400
there's on the flow cell here

137
00:04:39,590 --> 00:04:37,840
we're going to send up uh samples that

138
00:04:42,310 --> 00:04:39,600

we've prepared on the ground and the

139

00:04:43,990 --> 00:04:42,320

crew is going to thaw them out and

140

00:04:46,230 --> 00:04:44,000

basically inject them into a little

141

00:04:48,790 --> 00:04:46,240

sample port close it and then they push

142

00:04:50,550 --> 00:04:48,800

go and then the molecules flow down into

143

00:04:52,150 --> 00:04:50,560

this there's a little chip here that has

144

00:04:55,189 --> 00:04:52,160

nanopores

145

00:04:58,870 --> 00:04:55,199

and as the dna or rna passes through the

146

00:05:00,790 --> 00:04:58,880

nanopore you get a change in current

147

00:05:02,469 --> 00:05:00,800

that's diagnostic of the sequence and so

148

00:05:04,230 --> 00:05:02,479

you can from those changes and current

149

00:05:06,070 --> 00:05:04,240

get back what the sequence

150

00:05:08,310 --> 00:05:06,080

of the dna was

151

00:05:10,790 --> 00:05:08,320

and so for the first flight it's just a

152

00:05:13,110 --> 00:05:10,800

tech demonstration basically does do all

153

00:05:15,830 --> 00:05:13,120

the fluidics work uh is it can the crew

154

00:05:16,629 --> 00:05:15,840

members load the sample with space

155

00:05:18,070 --> 00:05:16,639

um

156

00:05:19,270 --> 00:05:18,080

that sort of thing what what challenges

157

00:05:20,310 --> 00:05:19,280

are there how well does the device

158

00:05:22,150 --> 00:05:20,320

perform

159

00:05:23,590 --> 00:05:22,160

and then in the future we'd like to

160

00:05:24,950 --> 00:05:23,600

build where we're actually doing the

161

00:05:28,870 --> 00:05:24,960

sample prep

162

00:05:30,629 --> 00:05:28,880

yeah because we haven't done this before

163

00:05:32,870 --> 00:05:30,639

so we need to make sure we know that

164

00:05:34,950 --> 00:05:32,880

it's it's actually working properly in

165

00:05:36,950 --> 00:05:34,960

microgravity if there would be any

166

00:05:40,150 --> 00:05:36,960

changes or anything like that to that

167

00:05:42,310 --> 00:05:40,160

device um and so what what do the

168

00:05:44,629 --> 00:05:42,320

astronauts do they will be loading the

169

00:05:45,749 --> 00:05:44,639

samples into the device as well yeah

170

00:05:47,670 --> 00:05:45,759

when they're in space when they're doing

171

00:05:49,510 --> 00:05:47,680

this okay and i understand you're also

172

00:05:51,510 --> 00:05:49,520

performing some testing here on earth

173

00:05:53,189 --> 00:05:51,520

can you tell me about

174

00:05:54,710 --> 00:05:53,199

yeah so we're

175

00:05:56,150 --> 00:05:54,720

basically to try and eliminate as many

176

00:05:58,550 --> 00:05:56,160

variables as we can we're going to

177

00:06:00,230 --> 00:05:58,560

prepare um identical samples that they

178

00:06:01,110 --> 00:06:00,240

have in flight we'll have them on the

179

00:06:02,550 --> 00:06:01,120

ground

180

00:06:03,830 --> 00:06:02,560

and as close as we can to when the

181

00:06:05,110 --> 00:06:03,840

astronaut

182

00:06:07,670 --> 00:06:05,120

is actually doing the experiment we're

183

00:06:10,870 --> 00:06:07,680

going to try to sequence the same sample

184

00:06:12,870 --> 00:06:10,880

on earth so that we'll know

185

00:06:14,230 --> 00:06:12,880

basically how well the sample is

186

00:06:15,749 --> 00:06:14,240

performing

187

00:06:17,670 --> 00:06:15,759

so that basically hopefully the only

188

00:06:19,029 --> 00:06:17,680

variable will be the actual microgravity

189

00:06:20,790 --> 00:06:19,039

environment

190

00:06:22,550 --> 00:06:20,800

rather than you know well if it's a

191

00:06:24,070 --> 00:06:22,560

different sample or

192

00:06:26,390 --> 00:06:24,080

some process is different it's sat

193

00:06:28,309 --> 00:06:26,400

around for a longer period of time

194

00:06:30,070 --> 00:06:28,319

great well thank you so much for coming

195

00:06:31,749 --> 00:06:30,080

out today and talking about this when

196

00:06:33,670 --> 00:06:31,759

does this launch

197

00:06:35,670 --> 00:06:33,680

again set in

198

00:06:37,590 --> 00:06:35,680

spring spring time of next year okay so

199

00:06:39,670 --> 00:06:37,600

we look forward to uh

200

00:06:41,590 --> 00:06:39,680

hearing all about that and good luck on

