
VOICE OF
Dr. Timothy Hammond
Principal Investigator, APEX-02

1
00:00:05,030 --> 00:00:02,790
one of the experiments that's just

2
00:00:08,150 --> 00:00:05,040
delivered to the station inside that

3
00:00:10,629 --> 00:00:08,160
spacex dragon cargo vehicle is

4
00:00:12,549 --> 00:00:10,639
investigating how cells adapt to

5
00:00:14,950 --> 00:00:12,559
stresses they encounter from being in

6
00:00:17,510 --> 00:00:14,960
the low earth orbit weightless

7
00:00:21,029 --> 00:00:17,520
environment it's called the advanced

8
00:00:23,029 --> 00:00:21,039
plant experiments 2 or apex 2

9
00:00:25,429 --> 00:00:23,039
and this morning we're going to learn

10
00:00:26,470 --> 00:00:25,439
about it from principal investigator dr

11
00:00:29,109 --> 00:00:26,480
timothy

12
00:00:31,269 --> 00:00:29,119
hammond of the durham veterans

13
00:00:33,430 --> 00:00:31,279

veterans affairs medical center and duke

14
00:00:35,830 --> 00:00:33,440
university school of medicine in durham

15
00:00:38,310 --> 00:00:35,840
north carolina dr hammond thanks for

16
00:00:42,069 --> 00:00:38,320
joining us on space station live

17
00:00:45,830 --> 00:00:43,990
that's great to have you here it's hard

18
00:00:48,549 --> 00:00:45,840
it's hard enough to figure out why

19
00:00:51,830 --> 00:00:48,559
entire organisms react as they do

20
00:00:55,350 --> 00:00:51,840
but tell us why you are focusing on the

21
00:00:57,350 --> 00:00:55,360
on the cellular level if you will

22
00:00:59,990 --> 00:00:57,360
we have the privilege of flying yeast

23
00:01:02,470 --> 00:01:00,000
which actually have about half the same

24
00:01:06,070 --> 00:01:02,480
genetic makeup as a person

25
00:01:07,030 --> 00:01:06,080
and our long-term goal is to repurpose

26
00:01:10,710 --> 00:01:07,040
drugs

27
00:01:12,550 --> 00:01:10,720
expensive and finding one without side

28
00:01:15,429 --> 00:01:12,560
effects is difficult

29
00:01:18,149 --> 00:01:15,439
and in the va we have a commonest

30
00:01:20,789 --> 00:01:18,159
diagnosis is type 2 diabetes and the

31
00:01:22,469 --> 00:01:20,799
commonest medicine for that is metformin

32
00:01:24,149 --> 00:01:22,479
and what we have found is patients that

33
00:01:27,270 --> 00:01:24,159
take metformin for diabetes are

34
00:01:29,350 --> 00:01:27,280
protected from certain forms of cancer

35
00:01:30,469 --> 00:01:29,360
modeling that those cancers is difficult

36
00:01:31,830 --> 00:01:30,479
on the ground because in the middle of

37
00:01:32,950 --> 00:01:31,840
the cancer you have very little gas

38
00:01:35,429 --> 00:01:32,960

exchange

39
00:01:37,190 --> 00:01:35,439
and it's exactly the same in space you

40
00:01:39,109 --> 00:01:37,200
have very little convection the gases

41
00:01:41,990 --> 00:01:39,119
don't move like they do on the ground so

42
00:01:44,069 --> 00:01:42,000
we think space is a very good way to

43
00:01:45,910 --> 00:01:44,079
model the inside of a tumor and to look

44
00:01:47,830 --> 00:01:45,920
for new drugs

45
00:01:49,990 --> 00:01:47,840
let's see you're you're actually using

46
00:01:51,590 --> 00:01:50,000
brewers yeast for this experiment i

47
00:01:54,389 --> 00:01:51,600
understand what what makes that

48
00:01:56,709 --> 00:01:54,399
appropriate for this type of research

49
00:01:59,030 --> 00:01:56,719
brewers yeast is great because it's

50
00:02:01,590 --> 00:01:59,040
simple it's simple to grow

51
00:02:04,550 --> 00:02:01,600
we know every gene that it has

52
00:02:06,389 --> 00:02:04,560
and its control systems are very simple

53
00:02:10,150 --> 00:02:06,399
and it has some special enzymes that

54
00:02:13,110 --> 00:02:10,160
make it very easy to uh do sophisticated

55
00:02:16,150 --> 00:02:13,120
molecular biology and knock genes out so

56
00:02:17,830 --> 00:02:16,160
we actually have a series of genes a

57
00:02:20,470 --> 00:02:17,840
pool of genes

58
00:02:22,470 --> 00:02:20,480
of a full of strains in which one gene

59
00:02:23,430 --> 00:02:22,480
is knocked out of every

60
00:02:25,750 --> 00:02:23,440
strain

61
00:02:27,430 --> 00:02:25,760
a different gene and has been replaced

62
00:02:28,470 --> 00:02:27,440
by a piece of dna that we know its

63
00:02:32,150 --> 00:02:28,480

sequence

64
00:02:34,309 --> 00:02:32,160
and when we then grow the yeast under a

65
00:02:37,430 --> 00:02:34,319
pressure in this case space or space

66
00:02:38,309 --> 00:02:37,440
with or without a drug and that way we

67
00:02:39,509 --> 00:02:38,319
can

68
00:02:41,589 --> 00:02:39,519
count those

69
00:02:43,430 --> 00:02:41,599
bar codes as we call them what we put in

70
00:02:45,430 --> 00:02:43,440
and know what gave us survival advantage

71
00:02:47,270 --> 00:02:45,440
and disadvantage when the

72
00:02:48,229 --> 00:02:47,280
samples come back

73
00:02:50,470 --> 00:02:48,239
how

74
00:02:52,949 --> 00:02:50,480
does the experiment actually operate on

75
00:02:55,030 --> 00:02:52,959
the station in terms of autonomous crew

76
00:02:56,710 --> 00:02:55,040
involvement both

77
00:02:58,309 --> 00:02:56,720
well actually this time what we've done

78
00:03:00,229 --> 00:02:58,319
is we've put if you've ever seen a

79
00:03:02,550 --> 00:03:00,239
fluorescent jellyfish that glows green

80
00:03:04,949 --> 00:03:02,560
right the protein that makes it grow

81
00:03:07,509 --> 00:03:04,959
green has been isolated and we have its

82
00:03:09,430 --> 00:03:07,519
dna and we put that in front of every

83
00:03:12,550 --> 00:03:09,440
gene in the genome as well

84
00:03:15,670 --> 00:03:12,560
so it's spotted each strain reports on

85
00:03:17,750 --> 00:03:15,680
the when when a gene is transcribed it

86
00:03:19,350 --> 00:03:17,760
also transcribes that protein that makes

87
00:03:22,630 --> 00:03:19,360
a green fluorescence

88
00:03:24,309 --> 00:03:22,640

so we have plates that have 384

89
00:03:25,910 --> 00:03:24,319
different strains each one reporting a

90
00:03:28,070 --> 00:03:25,920
different gene

91
00:03:29,589 --> 00:03:28,080
and over 10 plates we can get the whole

92
00:03:32,710 --> 00:03:29,599
genome and there's actually a

93
00:03:35,270 --> 00:03:32,720
fluorescent plate reader on station we

94
00:03:37,430 --> 00:03:35,280
put one plate in a time we measure the

95
00:03:40,149 --> 00:03:37,440
gene expression every 10 minutes for 18

96
00:03:41,910 --> 00:03:40,159
hours and we get the entire ballet of

97
00:03:43,509 --> 00:03:41,920
how yeast responds to

98
00:03:47,030 --> 00:03:43,519
space

99
00:03:48,550 --> 00:03:47,040
that's just it's amazing how uh how that

100
00:03:51,589 --> 00:03:48,560
is planned to operate how are you going

101
00:03:53,589 --> 00:03:51,599
to be able to tell

102
00:03:56,470 --> 00:03:53,599
basically how the cells respond to the

103
00:03:57,910 --> 00:03:56,480
stresses uh on the from the orbital

104
00:03:59,670 --> 00:03:57,920
environment

105
00:04:02,149 --> 00:03:59,680
well because we have ground controls for

106
00:04:03,589 --> 00:04:02,159
comparison and our canadian uh

107
00:04:06,149 --> 00:04:03,599
collaborators who actually do the

108
00:04:07,910 --> 00:04:06,159
spotting canada has fantastic robotics

109
00:04:09,270 --> 00:04:07,920
just like they made the canadian arm for

110
00:04:11,350 --> 00:04:09,280
the international space station they

111
00:04:13,589 --> 00:04:11,360
have some very very good robotics

112
00:04:15,750 --> 00:04:13,599
and they just published a paper in

113
00:04:19,189 --> 00:04:15,760

science last week in which they look at

114
00:04:21,349 --> 00:04:19,199
3 700 different responses to stresses

115
00:04:23,670 --> 00:04:21,359
and drugs on the ground so that gives us

116
00:04:25,430 --> 00:04:23,680
a fantastic reference library so we

117
00:04:28,310 --> 00:04:25,440
really understand what's unique about

118
00:04:30,629 --> 00:04:28,320
space and what we can exploit in space

119
00:04:32,310 --> 00:04:30,639
that we can't do on the ground

120
00:04:34,629 --> 00:04:32,320
um and of course

121
00:04:36,710 --> 00:04:34,639
we'll talk about your goals to figure

122
00:04:39,749 --> 00:04:36,720
out are they to figure out which plants

123
00:04:41,830 --> 00:04:39,759
grow best in space or how to genetically

124
00:04:43,990 --> 00:04:41,840
engineer plants so that they can grow

125
00:04:45,350 --> 00:04:44,000
well in space or might even the findings

126
00:04:48,150 --> 00:04:45,360
be applied

127
00:04:49,749 --> 00:04:48,160
to cells of people who will actually be

128
00:04:51,749 --> 00:04:49,759
in space

129
00:04:53,030 --> 00:04:51,759
well actually where we're interested in

130
00:04:54,790 --> 00:04:53,040
helping the astronauts of course but

131
00:04:56,870 --> 00:04:54,800
we're interested in

132
00:04:59,510 --> 00:04:56,880
veteran patients in va hospitals and

133
00:05:01,110 --> 00:04:59,520
americans and american hospitals and in

134
00:05:03,110 --> 00:05:01,120
international countries

135
00:05:04,710 --> 00:05:03,120
what we want to do is repurpose drugs

136
00:05:07,029 --> 00:05:04,720
and we're interested in whether the lack

137
00:05:09,749 --> 00:05:07,039
of convection in space the lack of gas

138
00:05:10,629 --> 00:05:09,759

movement gives us a good model for tumor

139
00:05:12,629 --> 00:05:10,639
agents

140
00:05:14,469 --> 00:05:12,639
for anti-cancer drugs that are better

141
00:05:17,189 --> 00:05:14,479
than on the ground so what we will bring

142
00:05:19,430 --> 00:05:17,199
back is the knowledge which pathways

143
00:05:21,430 --> 00:05:19,440
attack tumors so that we can use those

144
00:05:22,870 --> 00:05:21,440
drugs or even design better drugs on the

145
00:05:25,590 --> 00:05:22,880
ground once we know the pathways

146
00:05:28,390 --> 00:05:25,600
involved well and you just i think it

147
00:05:31,670 --> 00:05:28,400
just answered my last question but um

148
00:05:34,550 --> 00:05:31,680
the unique i guess environment of space

149
00:05:36,550 --> 00:05:34,560
uh offers you actually that i assume you

150
00:05:37,590 --> 00:05:36,560
can have direct interaction with the

151
00:05:40,310 --> 00:05:37,600
crew

152
00:05:41,749 --> 00:05:40,320
as a principal investigator right

153
00:05:43,430 --> 00:05:41,759
we do we of course have to go through

154
00:05:45,430 --> 00:05:43,440
the capcom like everybody else like you

155
00:05:47,909 --> 00:05:45,440
see on tv

156
00:05:50,390 --> 00:05:47,919
but yes we can and we try to design an

157
00:05:53,590 --> 00:05:50,400
experiment that

158
00:05:55,430 --> 00:05:53,600
is fairly automated so we don't take so

159
00:05:56,790 --> 00:05:55,440
we have abundant crew time when we need

160
00:05:58,309 --> 00:05:56,800
it but we try not to overuse that

161
00:06:00,390 --> 00:05:58,319
privilege

162
00:06:02,950 --> 00:06:00,400
well we're certainly looking forward to

163
00:06:04,950 --> 00:06:02,960

hearing all about it even further and

164
00:06:06,790 --> 00:06:04,960
and we really appreciate you joining us

165
00:06:08,150 --> 00:06:06,800
today on space station live dr hammond