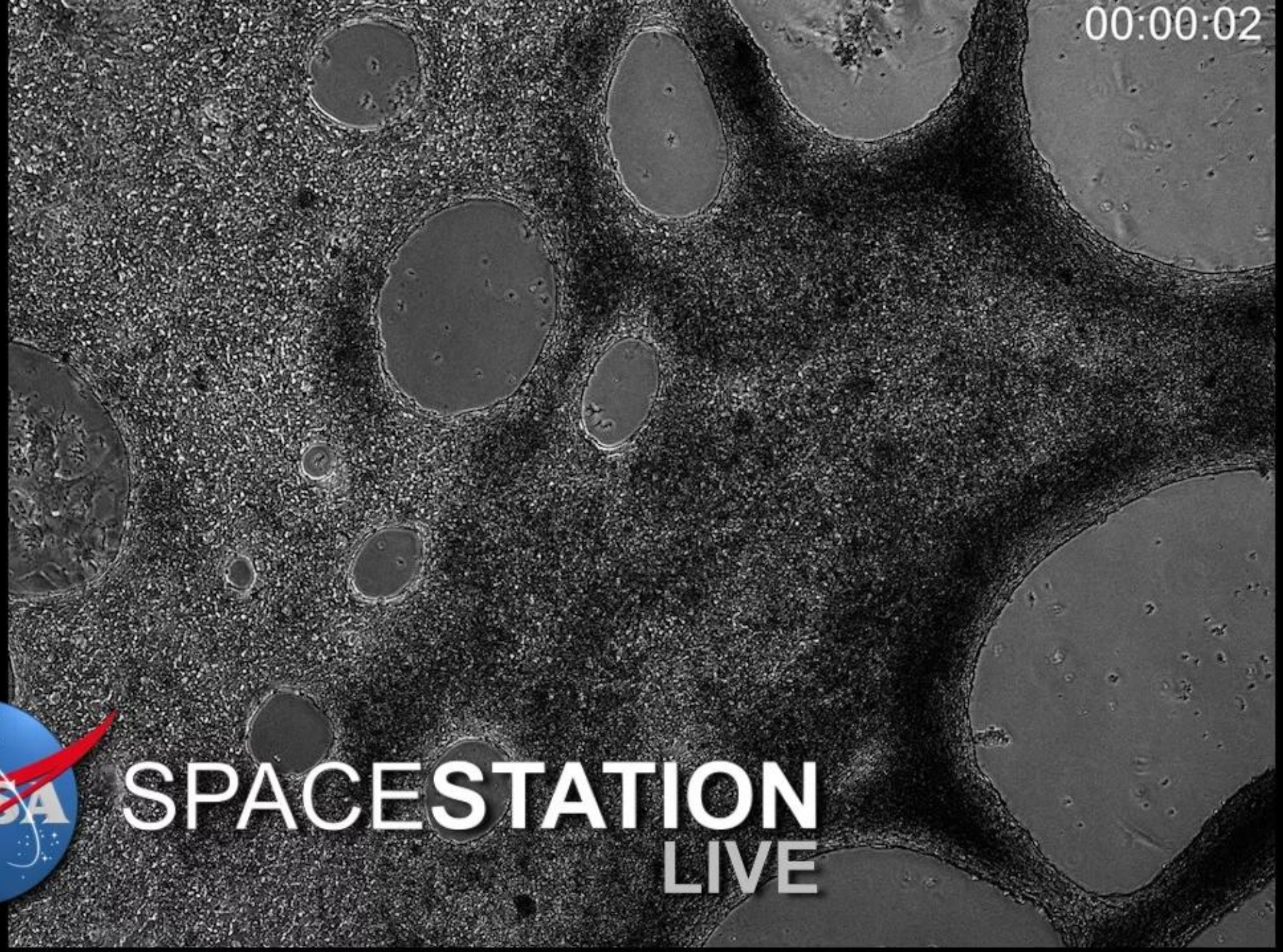
00:00:02
NASA
SPACESTATION
LIVE

1
00:00:10,709 --> 00:00:08,790
one aspect of the international space

2
00:00:12,709 --> 00:00:10,719
station's mission is to find out how the

3
00:00:14,789 --> 00:00:12,719
human body reacts to spending a long

4
00:00:16,870 --> 00:00:14,799
period of time in weightlessness as

5
00:00:18,870 --> 00:00:16,880
future astronauts will do on missions to

6
00:00:20,950 --> 00:00:18,880
mars and other destinations out into the

7
00:00:22,550 --> 00:00:20,960
solar system there is an experiment

8
00:00:24,710 --> 00:00:22,560
about to begin on the station that's

9
00:00:26,950 --> 00:00:24,720
focusing on the impacts to the human

10
00:00:28,470 --> 00:00:26,960
heart looking at potential changes to

11
00:00:30,710 --> 00:00:28,480
heart muscle cells

12
00:00:33,110 --> 00:00:30,720
recently my colleague pat ryan spoke

13
00:00:35,190 --> 00:00:33,120

with arun sharma of the stanford

14
00:00:37,110 --> 00:00:35,200
university school of medicine one of the

15
00:00:39,350 --> 00:00:37,120
co-investigators of the experiment known

16
00:00:41,270 --> 00:00:39,360
as heart cells and started by asking him

17
00:00:43,270 --> 00:00:41,280
to explain what negative effects to the

18
00:00:46,790 --> 00:00:43,280
human heart have been seen in astronauts

19
00:00:48,229 --> 00:00:46,800
after long-duration space missions

20
00:00:50,470 --> 00:00:48,239
right so it's been pretty well

21
00:00:52,869 --> 00:00:50,480
established by a number of studies that

22
00:00:55,590 --> 00:00:52,879
have come out over the recent years that

23
00:00:56,869 --> 00:00:55,600
the heart actually changes shape on the

24
00:00:59,430 --> 00:00:56,879
organ level

25
00:01:01,990 --> 00:00:59,440
so actually over a long-term exposure to

26
00:01:04,310 --> 00:01:02,000
microgravity the heart assumes more of a

27
00:01:07,270 --> 00:01:04,320
spherical shape as opposed to normally

28
00:01:08,070 --> 00:01:07,280
fist-like shape that it has a ground

29
00:01:09,750 --> 00:01:08,080
side

30
00:01:13,030 --> 00:01:09,760
and this is something that happens over

31
00:01:15,429 --> 00:01:13,040
a period of few weeks and usually that

32
00:01:17,990 --> 00:01:15,439
shape returns to normal after the

33
00:01:19,990 --> 00:01:18,000
astronauts return ground side in

34
00:01:23,350 --> 00:01:20,000
addition there is some

35
00:01:25,910 --> 00:01:23,360
somewhat of a muscle mass loss or muscle

36
00:01:28,070 --> 00:01:25,920
atrophy that happens as a result of

37
00:01:29,990 --> 00:01:28,080
long-term exposure to microgravity the

38
00:01:32,069 --> 00:01:30,000

heart and the other muscles in the body

39
00:01:34,550 --> 00:01:32,079
simply don't have to do as much work and

40
00:01:37,270 --> 00:01:34,560
so therefore to compensate they actually

41
00:01:39,910 --> 00:01:37,280
reduce some of their muscle mass

42
00:01:41,830 --> 00:01:39,920
does the change in shape impact the

43
00:01:45,429 --> 00:01:41,840
heart's efficiency

44
00:01:47,749 --> 00:01:45,439
it usually does not because it is not at

45
00:01:50,710 --> 00:01:47,759
a substantial enough level

46
00:01:53,109 --> 00:01:50,720
on orbit to do so

47
00:01:55,830 --> 00:01:53,119
is there a way to build back up the mass

48
00:01:58,310 --> 00:01:55,840
that it's lost i mean we do exercises

49
00:01:59,590 --> 00:01:58,320
for astronauts to try to recover other

50
00:02:01,109 --> 00:01:59,600
muscles that are impacted by

51
00:02:03,109 --> 00:02:01,119
weightlessness

52
00:02:04,789 --> 00:02:03,119
absolutely so the heart of course is

53
00:02:07,429 --> 00:02:04,799
just another muscle and it can be

54
00:02:09,190 --> 00:02:07,439
trained as well so you know once when

55
00:02:12,070 --> 00:02:09,200
the astronauts do their regular

56
00:02:12,949 --> 00:02:12,080
exercises on orbit their the heart will

57
00:02:15,430 --> 00:02:12,959
also

58
00:02:17,510 --> 00:02:15,440
uh be able to restore some of that lost

59
00:02:19,589 --> 00:02:17,520
muscle mass although the heart is

60
00:02:22,630 --> 00:02:19,599
actually a very unique and a very

61
00:02:24,869 --> 00:02:22,640
interesting organ because after

62
00:02:27,670 --> 00:02:24,879
something that does damage to the heart

63
00:02:31,030 --> 00:02:27,680

say a heart attack it actually does not

64
00:02:33,270 --> 00:02:31,040
replace a lot of its lost cells so for

65
00:02:35,430 --> 00:02:33,280
example a number of the other tissues in

66
00:02:37,670 --> 00:02:35,440
the body such as the skin have a really

67
00:02:40,309 --> 00:02:37,680
strong regenerative capacity

68
00:02:42,390 --> 00:02:40,319
but once heart cells are lost it's very

69
00:02:44,470 --> 00:02:42,400
difficult for them to come back

70
00:02:46,869 --> 00:02:44,480
i understand that you have to keep human

71
00:02:48,470 --> 00:02:46,879
heart cells in culture in order to study

72
00:02:50,390 --> 00:02:48,480
them in space

73
00:02:52,949 --> 00:02:50,400
so you and your colleagues have found a

74
00:02:55,830 --> 00:02:52,959
way to do that because doing it is a

75
00:02:57,110 --> 00:02:55,840
difficult thing you found a way to uh

76
00:02:59,990 --> 00:02:57,120
to do that in order to get the

77
00:03:01,910 --> 00:03:00,000
experiment samples to study explain what

78
00:03:03,910 --> 00:03:01,920
that process is

79
00:03:06,949 --> 00:03:03,920
absolutely so it's pretty tough to

80
00:03:09,030 --> 00:03:06,959
culture primary human heart tissue or

81
00:03:12,070 --> 00:03:09,040
human heart tissue from

82
00:03:13,910 --> 00:03:12,080
patients for a very long period of time

83
00:03:15,750 --> 00:03:13,920
our lab and other labs around the world

84
00:03:18,309 --> 00:03:15,760
are trying to figure out ways to keep

85
00:03:20,550 --> 00:03:18,319
these cells alive long-term in culture

86
00:03:22,470 --> 00:03:20,560
but so far we've only been able to do so

87
00:03:24,789 --> 00:03:22,480
for two to three weeks

88
00:03:26,550 --> 00:03:24,799

but recently over the last 10 years or

89
00:03:28,390 --> 00:03:26,560
so there have been revolutionary

90
00:03:31,190 --> 00:03:28,400
advances in the field of stem cell

91
00:03:34,070 --> 00:03:31,200
biology and this has enabled us to

92
00:03:36,710 --> 00:03:34,080
actually create heart cells from a type

93
00:03:40,710 --> 00:03:36,720
of stem cell population called an

94
00:03:43,030 --> 00:03:40,720
induced pluripotent stem cell or ipsc

95
00:03:45,750 --> 00:03:43,040
and to do this we basically take a small

96
00:03:48,470 --> 00:03:45,760
sample of a patient's own skin or blood

97
00:03:50,869 --> 00:03:48,480
cells usually white blood cells and we

98
00:03:54,309 --> 00:03:50,879
can reprogram these white blood cells

99
00:03:56,470 --> 00:03:54,319
into a stem cell-like state after about

100
00:03:59,190 --> 00:03:56,480
a one month long process

101
00:04:01,589 --> 00:03:59,200
and once those ipscs those induced

102
00:04:03,509 --> 00:04:01,599
pluripotent stem cells are created we

103
00:04:05,750 --> 00:04:03,519
can turn them into really whatever cell

104
00:04:08,550 --> 00:04:05,760
type we're interested in such as a brain

105
00:04:10,470 --> 00:04:08,560
cell liver cell skin cell and since

106
00:04:12,390 --> 00:04:10,480
we're a cardiovascular research

107
00:04:13,429 --> 00:04:12,400
institute we're interested in heart

108
00:04:15,270 --> 00:04:13,439
cells

109
00:04:17,990 --> 00:04:15,280
and so the protocol that we can actually

110
00:04:18,870 --> 00:04:18,000
use to create these heart cells from

111
00:04:21,830 --> 00:04:18,880
these

112
00:04:24,390 --> 00:04:21,840
ipsc stem cells is about a two week long

113
00:04:27,270 --> 00:04:24,400

process but at the end of the road we

114
00:04:29,749 --> 00:04:27,280
actually get these visually contracting

115
00:04:31,990 --> 00:04:29,759
these beating heart cells that you can

116
00:04:34,469 --> 00:04:32,000
see visually contract under a microscope

117
00:04:36,710 --> 00:04:34,479
or sometimes with your naked eye

118
00:04:38,629 --> 00:04:36,720
and these are the cells that you're

119
00:04:40,230 --> 00:04:38,639
about to launch to the space station to

120
00:04:41,830 --> 00:04:40,240
to study

121
00:04:43,990 --> 00:04:41,840
explain what happens once you get them

122
00:04:45,990 --> 00:04:44,000
to orbit how how long are they there

123
00:04:47,590 --> 00:04:46,000
what's the process are the human crew

124
00:04:49,909 --> 00:04:47,600
members helping

125
00:04:53,270 --> 00:04:49,919
exactly so we will be utilizing these

126
00:04:55,189 --> 00:04:53,280
ipsc derived heart cells as our model

127
00:04:58,070 --> 00:04:55,199
system to study the effects of

128
00:04:59,350 --> 00:04:58,080
microgravity on single cell function on

129
00:05:01,909 --> 00:04:59,360
heart function

130
00:05:03,990 --> 00:05:01,919
unlike primary human heart tissues these

131
00:05:06,629 --> 00:05:04,000
cells can actually survive for a very

132
00:05:08,070 --> 00:05:06,639
long time in cell culture so we've

133
00:05:10,469 --> 00:05:08,080
actually been able to grow them for

134
00:05:11,430 --> 00:05:10,479
longer than a year in our cell culture

135
00:05:13,350 --> 00:05:11,440
dishes

136
00:05:15,270 --> 00:05:13,360
and so once these cells are actually

137
00:05:18,390 --> 00:05:15,280
launched into orbit they'll be

138
00:05:21,510 --> 00:05:18,400

maintained on orbit for about one month

139
00:05:22,950 --> 00:05:21,520
in particular by dr kate rubins who is

140
00:05:26,070 --> 00:05:22,960
is now at the international space

141
00:05:29,590 --> 00:05:26,080
station and what dr rubins will be doing

142
00:05:31,350 --> 00:05:29,600
is changing the nutrients on these cells

143
00:05:33,749 --> 00:05:31,360
on a weekly basis

144
00:05:38,310 --> 00:05:33,759
in addition she'll also be looking at

145
00:05:39,990 --> 00:05:38,320
changes in cell shape size beating rates

146
00:05:41,909 --> 00:05:40,000
uh these are some of the things that

147
00:05:43,430 --> 00:05:41,919
she'll be helping us out with

148
00:05:45,350 --> 00:05:43,440
and then they're gonna be brought back

149
00:05:47,029 --> 00:05:45,360
to earth for you to study uh what are

150
00:05:48,710 --> 00:05:47,039
you looking for when you get these

151
00:05:51,909 --> 00:05:48,720
samples back in the lab

152
00:05:55,110 --> 00:05:51,919
yeah so we actually will have a parallel

153
00:05:57,430 --> 00:05:55,120
set of samples round side controls

154
00:05:59,909 --> 00:05:57,440
which will compare our space flown

155
00:06:00,950 --> 00:05:59,919
samples once they actually return to the

156
00:06:03,110 --> 00:06:00,960
lab

157
00:06:05,670 --> 00:06:03,120
and this is important because we'll be

158
00:06:08,150 --> 00:06:05,680
able to see what are the exact what is

159
00:06:09,749 --> 00:06:08,160
the impact of microgravity in particular

160
00:06:12,070 --> 00:06:09,759
on changing

161
00:06:14,550 --> 00:06:12,080
cells size cell shape

162
00:06:17,029 --> 00:06:14,560
cell beating rates and also another

163
00:06:18,550 --> 00:06:17,039

factor gene expression we want to be

164
00:06:21,510 --> 00:06:18,560
able to see what's the effect of

165
00:06:23,510 --> 00:06:21,520
microgravity on alterating altering the

166
00:06:24,629 --> 00:06:23,520
gene expression of these space flown

167
00:06:27,990 --> 00:06:24,639
heart cells

168
00:06:29,749 --> 00:06:28,000
and this is by is comparing the two the

169
00:06:32,230 --> 00:06:29,759
cells that have been to space versus the

170
00:06:34,469 --> 00:06:32,240
ones that have stayed on earth

171
00:06:37,830 --> 00:06:34,479
exactly so we'll be comparing the ground

172
00:06:39,909 --> 00:06:37,840
side samples to our space flown samples

173
00:06:42,150 --> 00:06:39,919
would you imagine that i mean what is it

174
00:06:44,390 --> 00:06:42,160
you're trying to find could your results

175
00:06:46,550 --> 00:06:44,400
have some impact for astronauts as well

176
00:06:48,710 --> 00:06:46,560
as people with heart issues on earth

177
00:06:51,510 --> 00:06:48,720
potentially definitely yes i definitely

178
00:06:53,510 --> 00:06:51,520
think there is some application for

179
00:06:54,390 --> 00:06:53,520
regenerative medicine ground side as

180
00:06:56,629 --> 00:06:54,400
well

181
00:06:58,950 --> 00:06:56,639
as i mentioned earlier the heart is a

182
00:07:00,950 --> 00:06:58,960
really unique organ in that it has a

183
00:07:02,870 --> 00:07:00,960
very limited ability to regenerate

184
00:07:05,430 --> 00:07:02,880
itself and so we're always looking for

185
00:07:08,390 --> 00:07:05,440
novel new ways that we might be able to

186
00:07:09,749 --> 00:07:08,400
restore heart function after injury such

187
00:07:11,830 --> 00:07:09,759
as a heart attack

188
00:07:14,230 --> 00:07:11,840

and we really don't know what's the

189
00:07:17,029 --> 00:07:14,240
effect of microgravity on the single

190
00:07:17,990 --> 00:07:17,039
heart cell but we have a hypothesis that

191
00:07:20,790 --> 00:07:18,000
maybe

192
00:07:22,950 --> 00:07:20,800
this uh unique stimulus will be able to

193
00:07:25,270 --> 00:07:22,960
enhance cell division in a way that's

194
00:07:27,029 --> 00:07:25,280
not really possible ground side and so

195
00:07:29,830 --> 00:07:27,039
we're really excited to be able to use

196
00:07:32,870 --> 00:07:29,840
the international space station as a

197
00:07:35,350 --> 00:07:32,880
really unique resource and as a way to

198
00:07:37,830 --> 00:07:35,360
access a an environment that's not

199
00:07:39,589 --> 00:07:37,840
available here on earth it'll be

200
00:07:41,749 --> 00:07:39,599
interesting to uh to see what results

201
00:07:43,350 --> 00:07:41,759
you get thanks for taking a few minutes

202
00:07:45,350 --> 00:07:43,360
to explain what you're what you're

203
00:07:47,510 --> 00:07:45,360
working on

204
00:07:49,990 --> 00:07:47,520
no problem thank you for having me arun

205
00:07:50,950 --> 00:07:50,000
sharma of the stanford university school

206
00:07:53,270 --> 00:07:50,960
of medicine is one of the

207
00:07:54,950 --> 00:07:53,280
co-investigators on the experiment heart