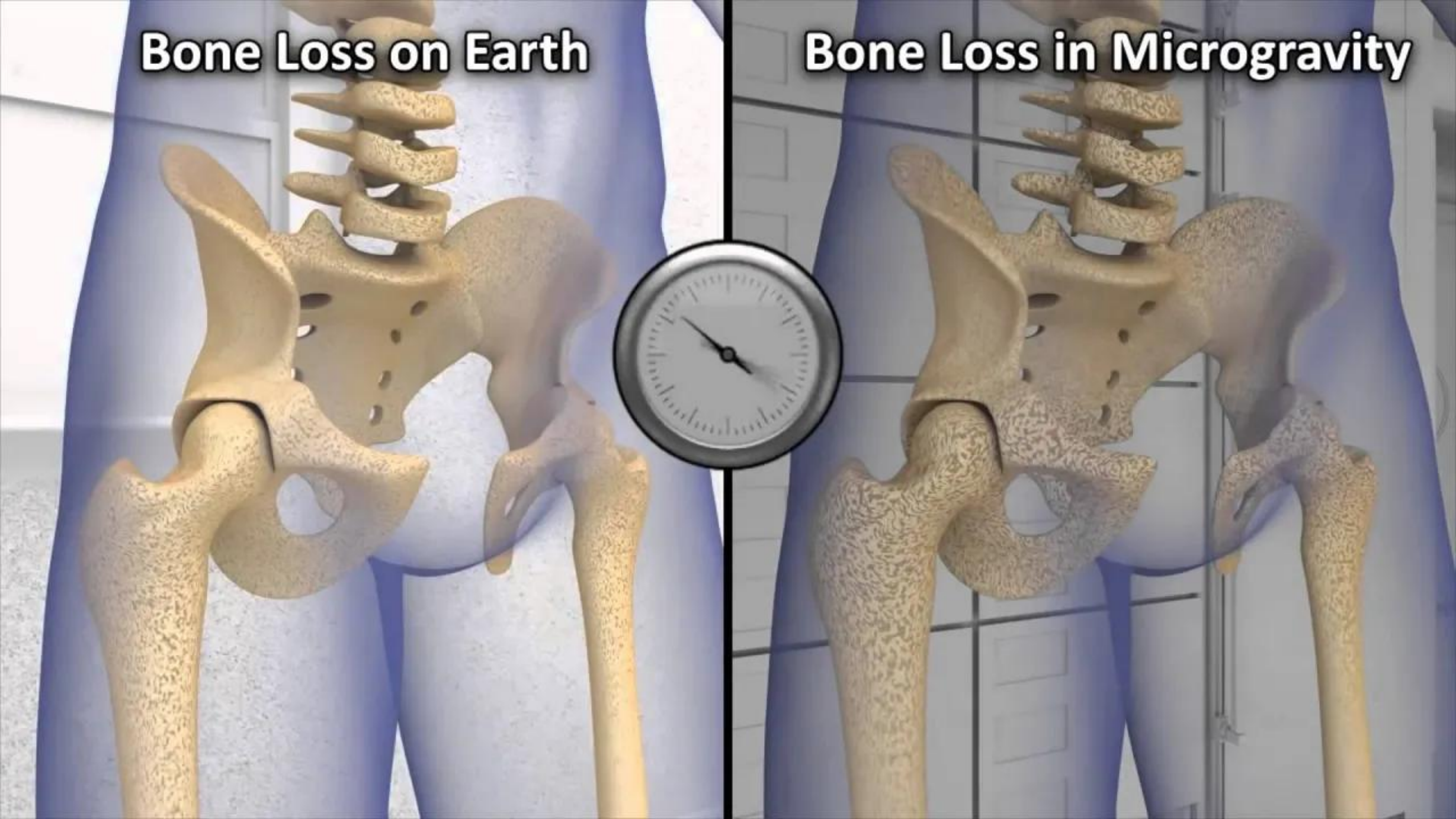
Bone Loss on Earth
Bone Loss in Microgravity

1
00:00:19,029 --> 00:00:16,790
hi i'm nasa astronaut tracy dyson

2
00:00:22,790 --> 00:00:19,039
welcome to station life you sit on two

3
00:00:25,589 --> 00:00:24,390
we're moving out there so you want to go

4
00:00:27,670 --> 00:00:25,599
right now

5
00:00:31,429 --> 00:00:27,680
thank you okay tracy we copy and that's

6
00:00:32,870 --> 00:00:31,439
good information we'll pass it along

7
00:00:35,270 --> 00:00:32,880
on today's show we're going to highlight

8
00:00:36,709 --> 00:00:35,280
for you how we here at nasa use the

9
00:00:38,790 --> 00:00:36,719
unique environment onboard the

10
00:00:40,709 --> 00:00:38,800
international space station to conduct

11
00:00:42,630 --> 00:00:40,719
groundbreaking research to better

12
00:00:43,750 --> 00:00:42,640
understand the science of nutrition off

13
00:00:47,270 --> 00:00:43,760

the earth

14
00:00:49,430 --> 00:00:47,280
as i learned from my time on board the

15
00:00:51,270 --> 00:00:49,440
international space station nutrition is

16
00:00:53,990 --> 00:00:51,280
vitally important to staying healthy and

17
00:00:56,310 --> 00:00:54,000
fit but there are some unique challenges

18
00:00:58,389 --> 00:00:56,320
to most basic nutrition practices that

19
00:01:00,389 --> 00:00:58,399
we take for granted here on earth

20
00:01:01,910 --> 00:01:00,399
for more insight on the role nutrition

21
00:01:04,630 --> 00:01:01,920
plays onboard the international space

22
00:01:08,149 --> 00:01:04,640
station here's don pettit katie coleman

23
00:01:10,870 --> 00:01:08,159
and chris hadfield on iss mailbag

24
00:01:13,030 --> 00:01:10,880
oh this guy stray trout

25
00:01:14,710 --> 00:01:13,040
one of my favorite guys oh straight

26
00:01:16,149 --> 00:01:14,720
trout

27
00:01:18,390 --> 00:01:16,159
okay

28
00:01:20,550 --> 00:01:18,400
um so what event the fishing guy is

29
00:01:23,109 --> 00:01:20,560
asking about food i like that

30
00:01:26,469 --> 00:01:23,119
yeah he's fishing for food

31
00:01:29,510 --> 00:01:26,479
so how is the food you eat in space

32
00:01:31,830 --> 00:01:29,520
different from on earth i tell people

33
00:01:33,190 --> 00:01:31,840
that nobody goes for the food i mean it

34
00:01:35,990 --> 00:01:33,200
all actually looks really pretty

35
00:01:38,630 --> 00:01:36,000
terrible the ambiance tastes pretty good

36
00:01:41,190 --> 00:01:38,640
and our food is a combination of

37
00:01:42,550 --> 00:01:41,200
dried food that we have to add water to

38
00:01:44,149 --> 00:01:42,560

and then there's what we call thermal

39
00:01:46,069 --> 00:01:44,159
stabilized and that means that it

40
00:01:47,429 --> 00:01:46,079
doesn't have to it can be it can get hot

41
00:01:49,749 --> 00:01:47,439
it can't get cold it's still going to be

42
00:01:51,830 --> 00:01:49,759
good food until we open it and then it's

43
00:01:53,190 --> 00:01:51,840
not good food anymore

44
00:01:55,030 --> 00:01:53,200
i'd say most of you know most of it

45
00:01:56,630 --> 00:01:55,040
tastes just fine i mean there's no i

46
00:01:58,469 --> 00:01:56,640
haven't actually eaten

47
00:02:00,310 --> 00:01:58,479
food i haven't had an urge to eat space

48
00:02:02,069 --> 00:02:00,320
food since i got back from space and

49
00:02:02,950 --> 00:02:02,079
that it's okay

50
00:02:06,709 --> 00:02:02,960
but

51
00:02:09,350 --> 00:02:06,719
it's substance okay it's it's healthy

52
00:02:10,790 --> 00:02:09,360
food it's good food it's like camped

53
00:02:13,430 --> 00:02:10,800
food and

54
00:02:15,190 --> 00:02:13,440
a lot of it is place utility it tastes

55
00:02:16,710 --> 00:02:15,200
really good when you're up there

56
00:02:18,869 --> 00:02:16,720
and it's fun

57
00:02:20,869 --> 00:02:18,879
actually it's fun eating eating food is

58
00:02:23,190 --> 00:02:20,879
an experience like a science experiment

59
00:02:26,070 --> 00:02:23,200
up there where you know you can take

60
00:02:28,070 --> 00:02:26,080
your tortilla and you can you know put

61
00:02:30,550 --> 00:02:28,080
peanut butter on it and spin it around

62
00:02:40,070 --> 00:02:30,560
and ah so in space you can play with

63
00:02:43,750 --> 00:02:41,670

imagine that

64
00:02:47,589 --> 00:02:43,760
you have no refrigerator

65
00:02:49,750 --> 00:02:47,599
you have no microwave you have no oven

66
00:02:51,990 --> 00:02:49,760
and your food has to arrive

67
00:02:54,390 --> 00:02:52,000
after having traveled thousands of miles

68
00:02:56,309 --> 00:02:54,400
in a really slow unrefrigerated vehicle

69
00:02:58,229 --> 00:02:56,319
what sort of food could you have and

70
00:03:00,630 --> 00:02:58,239
most of your food is like that it has to

71
00:03:02,470 --> 00:03:00,640
be packaged freeze-dried

72
00:03:04,790 --> 00:03:02,480
irradiated

73
00:03:06,390 --> 00:03:04,800
like military rations or like ramen

74
00:03:07,670 --> 00:03:06,400
noodles or like you're making faces

75
00:03:09,589 --> 00:03:07,680
while you're making a sex explanation

76
00:03:11,270 --> 00:03:09,599
most of the foods that were cans of food

77
00:03:13,190 --> 00:03:11,280
lots of lots of canned food that can

78
00:03:15,030 --> 00:03:13,200
last a long time it's very it's like the

79
00:03:17,030 --> 00:03:15,040
food you could carry in your backpack

80
00:03:19,750 --> 00:03:17,040
it's camping food yeah just camping food

81
00:03:21,830 --> 00:03:19,760
so but it's good i i i kept the same

82
00:03:23,030 --> 00:03:21,840
weight over uh my whole five months up

83
00:03:25,830 --> 00:03:23,040
there did you guys lose weight gain

84
00:03:27,350 --> 00:03:25,840
weight um lost weight gained weight a

85
00:03:29,270 --> 00:03:27,360
little of each a little bit how about

86
00:03:35,589 --> 00:03:29,280
you lost weight lost weight yeah yeah i

87
00:03:39,509 --> 00:03:36,949
but there's space

88
00:03:42,470 --> 00:03:39,519

utility there's place utility for the

89
00:03:45,430 --> 00:03:42,480
food it if you ate space food for dinner

90
00:03:47,670 --> 00:03:45,440
down here it'd be okay but

91
00:03:48,789 --> 00:03:47,680
but you you wouldn't go back for a

92
00:03:50,869 --> 00:03:48,799
second

93
00:03:52,309 --> 00:03:50,879
when you're in space

94
00:03:54,070 --> 00:03:52,319
in that environment it tastes really

95
00:03:55,830 --> 00:03:54,080
good and once in a while we get fresh

96
00:03:57,429 --> 00:03:55,840
food which is really nice when uh when

97
00:03:58,710 --> 00:03:57,439
an unmanned ship like one of the robot

98
00:04:00,390 --> 00:03:58,720
ships comes up

99
00:04:01,670 --> 00:04:00,400
one of the last things the technicians

100
00:04:03,030 --> 00:04:01,680
on the ground will often put in is a

101
00:04:04,949 --> 00:04:03,040
little bit of fresh stuff so you might

102
00:04:08,070 --> 00:04:04,959
get some fresh fruit or some fresh

103
00:04:09,990 --> 00:04:08,080
vegetables on ours we got lemons lemons

104
00:04:12,309 --> 00:04:10,000
they put in lemons we had like six

105
00:04:15,030 --> 00:04:12,319
onions

106
00:04:16,629 --> 00:04:15,040
do with those big ones well what do you

107
00:04:37,990 --> 00:04:16,639
do with i guess if you have lemons you

108
00:04:42,629 --> 00:04:39,830
our international space station is an

109
00:04:44,790 --> 00:04:42,639
unprecedented research platform in space

110
00:04:46,710 --> 00:04:44,800
allowing scientists from all around the

111
00:04:48,870 --> 00:04:46,720
world to conduct experiments that can't

112
00:04:51,030 --> 00:04:48,880
be done anywhere else

113
00:04:52,950 --> 00:04:51,040

over 1500 investigations have been

114
00:04:54,629 --> 00:04:52,960
completed or are ongoing in the

115
00:04:56,550 --> 00:04:54,639
following disciplines

116
00:04:58,629 --> 00:04:56,560
human health and performance

117
00:05:00,070 --> 00:04:58,639
technology testing for enabling future

118
00:05:01,590 --> 00:05:00,080
exploration

119
00:05:03,430 --> 00:05:01,600
physical science

120
00:05:06,070 --> 00:05:03,440
earth and space science

121
00:05:07,830 --> 00:05:06,080
biology and biotechnology

122
00:05:10,230 --> 00:05:07,840
the wonder of science in space is

123
00:05:14,310 --> 00:05:10,240
probably best described in our series

124
00:05:16,469 --> 00:05:14,320
iss science garage arctica antarctica or

125
00:05:17,990 --> 00:05:16,479
maybe mobile applications like if you're

126
00:05:21,270 --> 00:05:18,000
on some kind of vessel and you want to

127
00:05:24,469 --> 00:05:21,280
grow some garden greens to spice up your

128
00:05:26,390 --> 00:05:24,479
food or something like that spacecraft

129
00:05:27,909 --> 00:05:26,400
you know colonization you're going away

130
00:05:29,270 --> 00:05:27,919
from planet earth you're probably going

131
00:05:32,550 --> 00:05:29,280
to be using

132
00:05:34,550 --> 00:05:32,560
uh either hydroponics or aeroponics to

133
00:05:37,189 --> 00:05:34,560
grow your plants okay so it's it's a

134
00:05:40,310 --> 00:05:37,199
space it's driven by a space need at

135
00:05:42,310 --> 00:05:40,320
least nasa has grabbed it and is uh

136
00:05:44,710 --> 00:05:42,320
running with it for space but it has

137
00:05:47,350 --> 00:05:44,720
applications to all kinds it does

138
00:05:51,270 --> 00:05:47,360

and we are doing this on space station

139
00:05:52,870 --> 00:05:51,280
right now using aeroponic uh gardening

140
00:05:53,990 --> 00:05:52,880
techniques

141
00:05:56,070 --> 00:05:54,000
to

142
00:05:57,749 --> 00:05:56,080
raise plants uh in the orbital

143
00:06:01,029 --> 00:05:57,759
environment on space stations i wanted

144
00:06:03,590 --> 00:06:01,039
to see could you have a potted plant in

145
00:06:05,749 --> 00:06:03,600
the corner and the answer was uh it's

146
00:06:06,870 --> 00:06:05,759
difficult to do but you can yes but it's

147
00:06:08,790 --> 00:06:06,880
important because you've got to grow up

148
00:06:10,629 --> 00:06:08,800
so i think isn't there like regular

149
00:06:13,270 --> 00:06:10,639
experiments on space oh there are there

150
00:06:15,590 --> 00:06:13,280
there are regular experiments that have

151
00:06:17,909 --> 00:06:15,600
formalized pieces of hardware with

152
00:06:20,390 --> 00:06:17,919
terrariums and and all of that stuff and

153
00:06:23,510 --> 00:06:20,400
and they use aeroponics to grow these

154
00:06:25,590 --> 00:06:23,520
seeds and and and that's part of a uh a

155
00:06:27,189 --> 00:06:25,600
big principle investigator experience

156
00:06:29,510 --> 00:06:27,199
i'm gonna do it that way you know i just

157
00:06:31,430 --> 00:06:29,520
i like i i flew with seeds and then i

158
00:06:33,189 --> 00:06:31,440
tried to figure out how to do this once

159
00:06:36,150 --> 00:06:33,199
i got on or your plants were pretty big

160
00:06:37,749 --> 00:06:36,160
you told me i had a sunflower i was able

161
00:06:40,070 --> 00:06:37,759
to grow a sunflower it was a meter and a

162
00:06:41,590 --> 00:06:40,080
half long from a seed yeah and a bloomed

163
00:06:43,510 --> 00:06:41,600

and a maid seeds all right so i'm

164
00:06:44,870 --> 00:06:43,520
guessing these these experiments from

165
00:06:46,710 --> 00:06:44,880
these principal investigators didn't

166
00:06:47,909 --> 00:06:46,720
have anything really big well they they

167
00:06:49,589 --> 00:06:47,919
you know they maybe they have a growth

168
00:06:50,870 --> 00:06:49,599
chamber about like that or maybe a

169
00:06:52,390 --> 00:06:50,880
growth chamber is like this but yours

170
00:06:54,309 --> 00:06:52,400
was out in the open mine was out in the

171
00:06:55,749 --> 00:06:54,319
open so you had like a garden going on

172
00:06:57,350 --> 00:06:55,759
well i don't know what i call it a

173
00:06:59,350 --> 00:06:57,360
garden but i think i would call it i

174
00:07:00,550 --> 00:06:59,360
would call it like a guard so you had

175
00:07:02,469 --> 00:07:00,560
like a park

176
00:07:03,909 --> 00:07:02,479
so the space zucchini

177
00:07:06,550 --> 00:07:03,919
what were we saying you grew your own

178
00:07:08,070 --> 00:07:06,560
stuff yeah i i wanted to see whether you

179
00:07:10,230 --> 00:07:08,080
could have

180
00:07:12,629 --> 00:07:10,240
without a lot of equipment that took

181
00:07:14,469 --> 00:07:12,639
power and computer control and all that

182
00:07:16,390 --> 00:07:14,479
just the equivalent of a potted plant in

183
00:07:19,909 --> 00:07:16,400
the corner in space station

184
00:07:21,670 --> 00:07:19,919
right and so i brought a few seeds i

185
00:07:24,950 --> 00:07:21,680
brought zucchini

186
00:07:26,230 --> 00:07:24,960
broccoli and sunflower i figured those

187
00:07:28,950 --> 00:07:26,240
would be

188
00:07:30,870 --> 00:07:28,960

good things to try and

189
00:07:32,390 --> 00:07:30,880
experiment a number of different

190
00:07:33,909 --> 00:07:32,400
concepts of trying to grow these

191
00:07:35,909 --> 00:07:33,919
aeroponically

192
00:07:38,550 --> 00:07:35,919
passive aeroponics so it didn't have

193
00:07:40,550 --> 00:07:38,560
pumps and motors and stuff like that

194
00:07:42,390 --> 00:07:40,560
moving around just with plastic bags

195
00:07:45,589 --> 00:07:42,400
passively sitting there in front of

196
00:07:47,670 --> 00:07:45,599
light on station using nutrients

197
00:07:49,670 --> 00:07:47,680
composted from food so i started a

198
00:07:53,110 --> 00:07:49,680
little compost pile

199
00:07:54,790 --> 00:07:53,120
and i was able to have space zucchini in

200
00:07:57,029 --> 00:07:54,800
which you didn't eat this of course no

201
00:08:00,070 --> 00:07:57,039
no no because he became

202
00:08:02,869 --> 00:08:00,080
uh like a crew member now sunflower

203
00:08:04,869 --> 00:08:02,879
normally grows really straight stalks

204
00:08:06,710 --> 00:08:04,879
right right yeah which is organic so and

205
00:08:07,830 --> 00:08:06,720
so i had the sunflower a meter and a

206
00:08:14,150 --> 00:08:07,840
half

207
00:08:16,469 --> 00:08:14,160
and the stock was like that thick the

208
00:08:20,070 --> 00:08:16,479
stock was maybe three millimeters thick

209
00:08:23,270 --> 00:08:20,080
so it didn't put any energy into making

210
00:08:25,589 --> 00:08:23,280
the stock because it didn't need tow so

211
00:08:28,309 --> 00:08:25,599
the stock how big is the stock on the

212
00:08:29,510 --> 00:08:28,319
beefy yeah you know a sunflower that'd

213
00:08:32,630 --> 00:08:29,520

be a meter and a half tall would

214
00:08:34,790 --> 00:08:32,640
probably have a stock maybe uh six seven

215
00:08:37,509 --> 00:08:34,800
eight millimeters in diameter this is

216
00:08:40,709 --> 00:08:37,519
less than half yes and so

217
00:08:43,509 --> 00:08:40,719
the sunflower is kind of like human

218
00:08:46,070 --> 00:08:43,519
beads and that they're inherently lazy

219
00:08:48,070 --> 00:08:46,080
and if they don't have to put the energy

220
00:08:50,790 --> 00:08:48,080
into making a stock to stand up they

221
00:08:52,949 --> 00:08:50,800
don't so that stock would not

222
00:08:54,710 --> 00:08:52,959
work it would not work on a fallover

223
00:08:57,269 --> 00:08:54,720
yeah and and another thing that

224
00:08:59,269 --> 00:08:57,279
sunflower stalks are straight

225
00:09:01,670 --> 00:08:59,279
yeah this stock was

226
00:09:02,870 --> 00:09:01,680
just all curvier we naturally go

227
00:09:04,150 --> 00:09:02,880
but what would you what so what's the

228
00:09:05,430 --> 00:09:04,160
idea so you have these little things

229
00:09:07,350 --> 00:09:05,440
that you really can't get anything you

230
00:09:09,509 --> 00:09:07,360
can eat right you've had this stuff

231
00:09:10,949 --> 00:09:09,519
growing in the hallway yeah in space

232
00:09:13,269 --> 00:09:10,959
there's a million module and you could

233
00:09:14,710 --> 00:09:13,279
eat that stuff you could so what what

234
00:09:16,630 --> 00:09:14,720
would you think if you're going on a

235
00:09:17,750 --> 00:09:16,640
trip to mars let's say and you need to

236
00:09:19,030 --> 00:09:17,760
grow some

237
00:09:21,030 --> 00:09:19,040
vegetables or

238
00:09:22,470 --> 00:09:21,040

fruit or i guess i don't know whatever

239
00:09:24,150 --> 00:09:22,480
you want to grow

240
00:09:27,470 --> 00:09:24,160
uh how would what do you think the idea

241
00:09:29,910 --> 00:09:27,480
well you would want to have a genuine

242
00:09:32,070 --> 00:09:29,920
design-engineered gross chamber based

243
00:09:34,230 --> 00:09:32,080
off of aeroponics and you would want to

244
00:09:35,829 --> 00:09:34,240
bring you have a farm basically yeah you

245
00:09:37,509 --> 00:09:35,839
you'd have a small

246
00:09:39,269 --> 00:09:37,519
farm module yeah

247
00:09:40,870 --> 00:09:39,279
that's right a farm module i like that

248
00:09:42,070 --> 00:09:40,880
concept all right so that's you and you

249
00:09:44,710 --> 00:09:42,080
would set it up right so the stuff has

250
00:09:46,949 --> 00:09:44,720
enough room to grow enough room to grow

251
00:09:49,190 --> 00:09:46,959
with with adequate lighting and and

252
00:09:51,750 --> 00:09:49,200
you'd provide the nutrients and you do

253
00:09:53,750 --> 00:09:51,760
it in an aeroponic manner and you could

254
00:09:56,389 --> 00:09:53,760
grow a significant

255
00:09:58,230 --> 00:09:56,399
amount of

256
00:10:18,389 --> 00:09:58,240
pleasant trees to add to your normal

257
00:10:22,550 --> 00:10:20,230
this month our focus is on nutrition

258
00:10:23,670 --> 00:10:22,560
research onboard our international space

259
00:10:25,990 --> 00:10:23,680
station

260
00:10:28,630 --> 00:10:26,000
living in space for six months changes

261
00:10:31,110 --> 00:10:28,640
our bodies in a number of ways

262
00:10:33,750 --> 00:10:31,120
we lose bone mineral density our muscles

263
00:10:36,069 --> 00:10:33,760

atrophy our cardiovascular system gets

264
00:10:37,829 --> 00:10:36,079
weaker and we experience immune system

265
00:10:40,069 --> 00:10:37,839
dysfunction

266
00:10:41,590 --> 00:10:40,079
one way of understanding our bodies and

267
00:10:43,430 --> 00:10:41,600
how they change during the course of a

268
00:10:45,509 --> 00:10:43,440
long-duration space mission

269
00:10:48,870 --> 00:10:45,519
is to study our bodily fluids taken at

270
00:10:50,710 --> 00:10:48,880
specific times throughout our mission

271
00:10:53,269 --> 00:10:50,720
these samples provide scientists with

272
00:10:55,190 --> 00:10:53,279
information on bone metabolism

273
00:10:58,870 --> 00:10:55,200
oxidative damage

274
00:11:00,710 --> 00:10:58,880
body chemistry and hormonal changes

275
00:11:02,790 --> 00:11:00,720
an increased understanding of the role

276
00:11:05,030 --> 00:11:02,800
that nutrition plays in the adaptation

277
00:11:06,389 --> 00:11:05,040
to space flight has broader application

278
00:11:08,230 --> 00:11:06,399
here on earth

279
00:11:11,350 --> 00:11:08,240
one example is that understanding the

280
00:11:13,509 --> 00:11:11,360
relationship of nutrition to bone loss

281
00:11:15,750 --> 00:11:13,519
is potentially valuable for patients

282
00:11:17,110 --> 00:11:15,760
suffering from osteoporosis here on

283
00:11:18,870 --> 00:11:17,120
earth

284
00:11:20,470 --> 00:11:18,880
we're using the space station to study

285
00:11:22,630 --> 00:11:20,480
the risks to human health that are

286
00:11:23,910 --> 00:11:22,640
inherent in space exploration

287
00:11:25,990 --> 00:11:23,920
let's take a look at what we have

288
00:11:28,230 --> 00:11:26,000

learned off the earth about proper

289
00:11:30,630 --> 00:11:28,240
nutrition combined with high intensity

290
00:11:34,069 --> 00:11:30,640
exercise in helping to treat better

291
00:11:36,150 --> 00:11:34,079
osteoporosis here on the earth

292
00:11:38,710 --> 00:11:36,160
the bones in our bodies are alive

293
00:11:40,069 --> 00:11:38,720
growing and changing all the time

294
00:11:41,910 --> 00:11:40,079
our bones are composed of different

295
00:11:44,310 --> 00:11:41,920
layers the outer surface of bone is

296
00:11:45,910 --> 00:11:44,320
called cortical bone this is the smooth

297
00:11:47,829 --> 00:11:45,920
hard part of the bone that we can see

298
00:11:49,670 --> 00:11:47,839
when we look at a skeleton inside the

299
00:11:51,590 --> 00:11:49,680
cortical bone is the trabecular bone

300
00:11:54,710 --> 00:11:51,600
this type of bone looks like a sponge

301
00:11:56,550 --> 00:11:54,720
and helps to protect the bone marrow

302
00:11:59,269 --> 00:11:56,560
the constant process of bones growing

303
00:12:00,949 --> 00:11:59,279
and changing is known as bone remodeling

304
00:12:03,069 --> 00:12:00,959
this process is carried out by specific

305
00:12:05,190 --> 00:12:03,079
cells in our bones cells called

306
00:12:07,190 --> 00:12:05,200
osteoclasts have the role of breaking

307
00:12:09,190 --> 00:12:07,200
down our bone and removing any parts

308
00:12:10,590 --> 00:12:09,200
that need replacing

309
00:12:13,110 --> 00:12:10,600
at the same time cells called

310
00:12:14,949 --> 00:12:13,120
osteoblasts have the job of making new

311
00:12:17,030 --> 00:12:14,959
bone and helping to repair any parts of

312
00:12:19,269 --> 00:12:17,040
the bone that had been damaged

313
00:12:21,190 --> 00:12:19,279

on earth in healthy individuals this

314
00:12:23,430 --> 00:12:21,200
process is normally balanced so that the

315
00:12:28,069 --> 00:12:23,440
same amount of bone is made and broken

316
00:12:32,150 --> 00:12:30,150
in space astronauts are exposed to lower

317
00:12:33,670 --> 00:12:32,160
levels of gravity than on earth this

318
00:12:35,110 --> 00:12:33,680
means that they have less mechanical

319
00:12:36,230 --> 00:12:35,120
stress put on their bones as they move

320
00:12:37,750 --> 00:12:36,240
around

321
00:12:39,350 --> 00:12:37,760
scientists believe that the bones

322
00:12:41,030 --> 00:12:39,360
naturally try to adapt to this new

323
00:12:42,310 --> 00:12:41,040
environment by increasing the rate that

324
00:12:44,949 --> 00:12:42,320
the bone is broken down by the

325
00:12:46,710 --> 00:12:44,959
osteoclasts meanwhile bone formation

326
00:12:48,310 --> 00:12:46,720
continues to occur at the same rate as

327
00:12:49,990 --> 00:12:48,320
it does on earth

328
00:12:51,750 --> 00:12:50,000
the result is an imbalance in bone

329
00:12:55,430 --> 00:12:51,760
remodeling which leads to an overall

330
00:12:57,190 --> 00:12:55,440
decrease in bone mineral density

331
00:12:58,550 --> 00:12:57,200
while in space astronauts can manage

332
00:13:00,710 --> 00:12:58,560
with lower bone density but when they

333
00:13:02,710 --> 00:13:00,720
return their bones are less able to cope

334
00:13:05,110 --> 00:13:02,720
with earth's gravity this increases the

335
00:13:06,470 --> 00:13:05,120
risk of fracture and injury scientists

336
00:13:08,710 --> 00:13:06,480
use many different tests to measure the

337
00:13:10,870 --> 00:13:08,720
density of the astronauts bones results

338
00:13:13,030 --> 00:13:10,880

show that the astronauts while in space

339
00:13:15,350 --> 00:13:13,040
lose bone in a similar pattern to people

340
00:13:17,269 --> 00:13:15,360
on earth who suffer from osteoporosis

341
00:13:20,470 --> 00:13:17,279
but the astronauts lose it at a much

342
00:13:22,230 --> 00:13:20,480
faster rate

343
00:13:23,910 --> 00:13:22,240
scientists have found that exercise when

344
00:13:26,470 --> 00:13:23,920
combined with good nutrition and

345
00:13:28,069 --> 00:13:26,480
increased vitamin d intake is able to

346
00:13:29,910 --> 00:13:28,079
preserve some of the bone that was

347
00:13:31,990 --> 00:13:29,920
previously being lost

348
00:13:33,910 --> 00:13:32,000
since 2008 astronauts have been able to

349
00:13:35,990 --> 00:13:33,920
use a new exercise machine called the

350
00:13:38,550 --> 00:13:36,000
advanced resistive exercise device or

351
00:13:40,470 --> 00:13:38,560
a-red it is thought that this increase

352
00:13:42,389 --> 00:13:40,480
in force triggers the formation of new

353
00:13:44,710 --> 00:13:42,399
bone bringing more balance to the bone

354
00:13:46,310 --> 00:13:44,720
remodeling process and allowing the bone

355
00:13:50,150 --> 00:13:46,320
density to stay at roughly the same

356
00:13:53,670 --> 00:13:51,670
it is a significant achievement to be

357
00:13:55,350 --> 00:13:53,680
able to maintain bone density in space

358
00:13:57,030 --> 00:13:55,360
but more experiments need to be carried

359
00:13:59,189 --> 00:13:57,040
out to see whether the new bone which is

360
00:14:01,030 --> 00:13:59,199
formed in space has the same structure

361
00:14:03,110 --> 00:14:01,040
and strength as new bone which is formed

362
00:14:05,030 --> 00:14:03,120
on earth understanding bone loss

363
00:14:07,110 --> 00:14:05,040

associated with microgravity may lead to

364
00:14:08,870 --> 00:14:07,120
better preventive care or therapeutic

365
00:14:10,949 --> 00:14:08,880
treatments for people on earth suffering

366
00:14:13,829 --> 00:14:10,959
bone loss as a result of bone diseases

367
00:14:27,350 --> 00:14:13,839
like ostopinia and osteoporosis or for

368
00:14:31,269 --> 00:14:29,750
in space and on earth our bodies require

369
00:14:33,430 --> 00:14:31,279
proper nutrition

370
00:14:35,829 --> 00:14:33,440
defining nutrient requirements for space

371
00:14:38,150 --> 00:14:35,839
flight and ensuring provision and intake

372
00:14:40,949 --> 00:14:38,160
of those nutrients are primary issues

373
00:14:44,230 --> 00:14:40,959
for astronaut health and mission success

374
00:14:46,550 --> 00:14:44,240
after all you are what you eat one

375
00:14:48,389 --> 00:14:46,560
challenge is providing appetizing food

376
00:14:51,430 --> 00:14:48,399
for astronauts that does not require

377
00:14:53,030 --> 00:14:51,440
refrigeration and has a long shelf life

378
00:14:55,110 --> 00:14:53,040
while the food is much better than you

379
00:14:57,269 --> 00:14:55,120
might imagine and we've come a long way

380
00:15:00,150 --> 00:14:57,279
since the beginning of space flight we

381
00:15:01,509 --> 00:15:00,160
do have limited access to fresh foods

382
00:15:03,990 --> 00:15:01,519
if you've ever prepared lunch for

383
00:15:06,069 --> 00:15:04,000
someone special you may wonder how food

384
00:15:07,990 --> 00:15:06,079
for our astronauts living and working on

385
00:15:10,550 --> 00:15:08,000
board the international space station is

386
00:15:13,189 --> 00:15:10,560
made and delivered in our next segment

387
00:15:15,350 --> 00:15:13,199
we're going inside nasa's space food

388
00:15:17,670 --> 00:15:15,360

systems laboratory as seen on the

389
00:15:23,430 --> 00:15:17,680
national geographic space station live

390
00:15:23,440 --> 00:15:29,590
eating in space is its own kind of fun

391
00:15:42,230 --> 00:15:31,829
but keeping astronauts fit and healthy

392
00:15:46,550 --> 00:15:44,470
michelle clinch is responsible for what

393
00:15:49,269 --> 00:15:46,560
they eat

394
00:15:51,670 --> 00:15:49,279
we're making spaghetti with meat sauce

395
00:15:53,990 --> 00:15:51,680
space meals begin just like ours do with

396
00:15:57,590 --> 00:15:54,000
a trip to the supermarket thank you but

397
00:16:02,790 --> 00:15:59,430
spaghetti and meat sauce is just one of

398
00:16:06,629 --> 00:16:02,800
the 250 things on the space station menu

399
00:16:09,189 --> 00:16:06,639
each portion is meticulously calibrated

400
00:16:12,150 --> 00:16:09,199
we have a database where we maintain the

401
00:16:15,189 --> 00:16:12,160
nutritional content of all our products

402
00:16:16,870 --> 00:16:15,199
calories fat protein carbohydrate things

403
00:16:18,949 --> 00:16:16,880
like that

404
00:16:20,870 --> 00:16:18,959
but the most important calculation is

405
00:16:23,110 --> 00:16:20,880
what things weigh

406
00:16:25,509 --> 00:16:23,120
that's because it cost ten thousand

407
00:16:27,910 --> 00:16:25,519
dollars for every pound blasted off to

408
00:16:30,389 --> 00:16:27,920
the astronauts

409
00:16:34,710 --> 00:16:30,399
so nasa adopted a reduction technique

410
00:16:39,269 --> 00:16:37,430
freeze drying removes a high percentage

411
00:16:40,949 --> 00:16:39,279
of the moisture so typically when we

412
00:16:44,790 --> 00:16:40,959
freeze dry our products we take them

413
00:16:54,629 --> 00:16:47,749

each portion now weighs just one ounce

414
00:17:00,389 --> 00:16:57,910
1300 miles away and the orbital cygnus

415
00:17:04,390 --> 00:17:00,399
resupply module is being loaded with the

416
00:17:08,870 --> 00:17:06,789
and it's time for a few last-minute food

417
00:17:10,710 --> 00:17:08,880
luxuries

418
00:17:13,669 --> 00:17:10,720
these are the tortillas they're very

419
00:17:15,909 --> 00:17:13,679
popular on orbit after a daily routine

420
00:17:18,390 --> 00:17:15,919
of freeze-dried meals a fresh piece of

421
00:17:20,150 --> 00:17:18,400
fruit is a welcome relief well worth its

422
00:17:21,909 --> 00:17:20,160
weight in gold

423
00:17:24,309 --> 00:17:21,919
as you can see we're only sending three

424
00:17:26,710 --> 00:17:24,319
apples so you may think that's unfair

425
00:17:28,390 --> 00:17:26,720
because we have six people on orbit they

426
00:17:30,710 --> 00:17:28,400
may have to share

427
00:17:33,430 --> 00:17:30,720
this very precious cargo is one of the

428
00:17:36,470 --> 00:17:33,440
last things to be loaded onto the rocket

429
00:17:43,350 --> 00:17:36,480
it's on its way three three two

430
00:17:48,549 --> 00:17:45,990
less than a kilometer away from us now

431
00:17:51,510 --> 00:17:48,559
two days later cygnus docks with the

432
00:17:57,190 --> 00:17:54,870
we're getting ready to birth the

433
00:17:59,110 --> 00:17:57,200
cygnus one vehicle all right looks

434
00:18:02,150 --> 00:17:59,120
really good perfect

435
00:18:04,070 --> 00:18:02,160
perfect nice bonus food

436
00:18:07,029 --> 00:18:04,080
including some surprise treats from

437
00:18:07,039 --> 00:18:11,350
look at that tortillas

438
00:18:15,510 --> 00:18:12,710

look at that

439
00:18:19,669 --> 00:18:17,590
oh my goodness gracious

440
00:18:22,070 --> 00:18:19,679
the greatest hot dog relish in the

441
00:18:24,470 --> 00:18:22,080
history of man

442
00:18:36,710 --> 00:18:24,480
oh my gosh my wife didn't tell me about

443
00:18:40,789 --> 00:18:38,710
what was my favorite food on board the

444
00:18:43,750 --> 00:18:40,799
international space station i would say

445
00:18:46,070 --> 00:18:43,760
my favorite food had to have been coffee

446
00:18:48,950 --> 00:18:46,080
with cream and sugar but

447
00:18:50,950 --> 00:18:48,960
my favorite meal on board was

448
00:18:52,549 --> 00:18:50,960
grilled pork chop

449
00:18:59,029 --> 00:18:52,559
asparagus

450
00:19:09,029 --> 00:19:01,190
my least favorite food was

451
00:19:12,549 --> 00:19:10,630
while in space the food i missed the

452
00:19:14,549 --> 00:19:12,559
most was actually lettuce

453
00:19:16,150 --> 00:19:14,559
we don't get fresh food very often

454
00:19:18,630 --> 00:19:16,160
onboard the space station and even when

455
00:19:22,830 --> 00:19:18,640
we do it goes really fast but i really

456
00:19:27,350 --> 00:19:25,029
lettuce i just finished eating and i

457
00:19:29,270 --> 00:19:27,360
have to enter in

458
00:19:31,270 --> 00:19:29,280
what i ate because the ground folks like

459
00:19:36,830 --> 00:19:31,280
to keep track of it

460
00:19:40,950 --> 00:19:38,950
calories how much salt we're getting how

461
00:19:42,789 --> 00:19:40,960
much protein things like that they track

462
00:19:44,150 --> 00:19:42,799
us closely on everything when we lift

463
00:19:46,549 --> 00:19:44,160

weights we have to keep track of how

464
00:19:48,150 --> 00:19:46,559
much weight we lift how many reps we do

465
00:19:50,150 --> 00:19:48,160
when we run on the treadmill and

466
00:19:51,909 --> 00:19:50,160
computers are recording our heart rate

467
00:19:53,590 --> 00:19:51,919
when we turn on lights when we turn on

468
00:19:54,950 --> 00:19:53,600
the toilet

469
00:19:56,950 --> 00:19:54,960
i learned on my first mission there are

470
00:19:58,870 --> 00:19:56,960
no secrets in space

471
00:20:01,270 --> 00:19:58,880
and we got video cameras and just about

472
00:20:02,070 --> 00:20:01,280
all the modules

473
00:20:03,190 --> 00:20:02,080
so

474
00:20:04,470 --> 00:20:03,200
it's basically like being in a big

475
00:20:07,190 --> 00:20:04,480
fishbowl the ground knows everything

476
00:20:10,070 --> 00:20:07,200
about us up here which is not that big a

477
00:20:27,270 --> 00:20:10,080
deal but it's something to keep in mind

478
00:20:31,990 --> 00:20:30,230
as you can see iss nutrition research is

479
00:20:34,390 --> 00:20:32,000
vital towards improving the quality of

480
00:20:35,909 --> 00:20:34,400
human health and well-being in space

481
00:20:37,750 --> 00:20:35,919
and on earth

482
00:20:40,390 --> 00:20:37,760
nasa is constantly looking for ways to

483
00:20:41,909 --> 00:20:40,400
benefit humanity as together we take the

484
00:20:43,990 --> 00:20:41,919
next steps towards exploring the

485
00:20:45,750 --> 00:20:44,000
universe searching for answers that

486
00:20:48,149 --> 00:20:45,760
matter to us most

487
00:20:49,830 --> 00:20:48,159
thanks for joining us on station life at

488
00:20:51,590 --> 00:20:49,840

our behind the scenes look at nutrition

489
00:20:53,830 --> 00:20:51,600
research aboard the international space

490
00:20:56,230 --> 00:20:53,840
station be sure to follow us on facebook

491
00:20:58,630 --> 00:20:56,240
and twitter for the latest research news